Aviation Week and Space Technology

December 18, 1961

USAF Requests Manned Lunar Rover Studies

Lockheed F-104s for Allies

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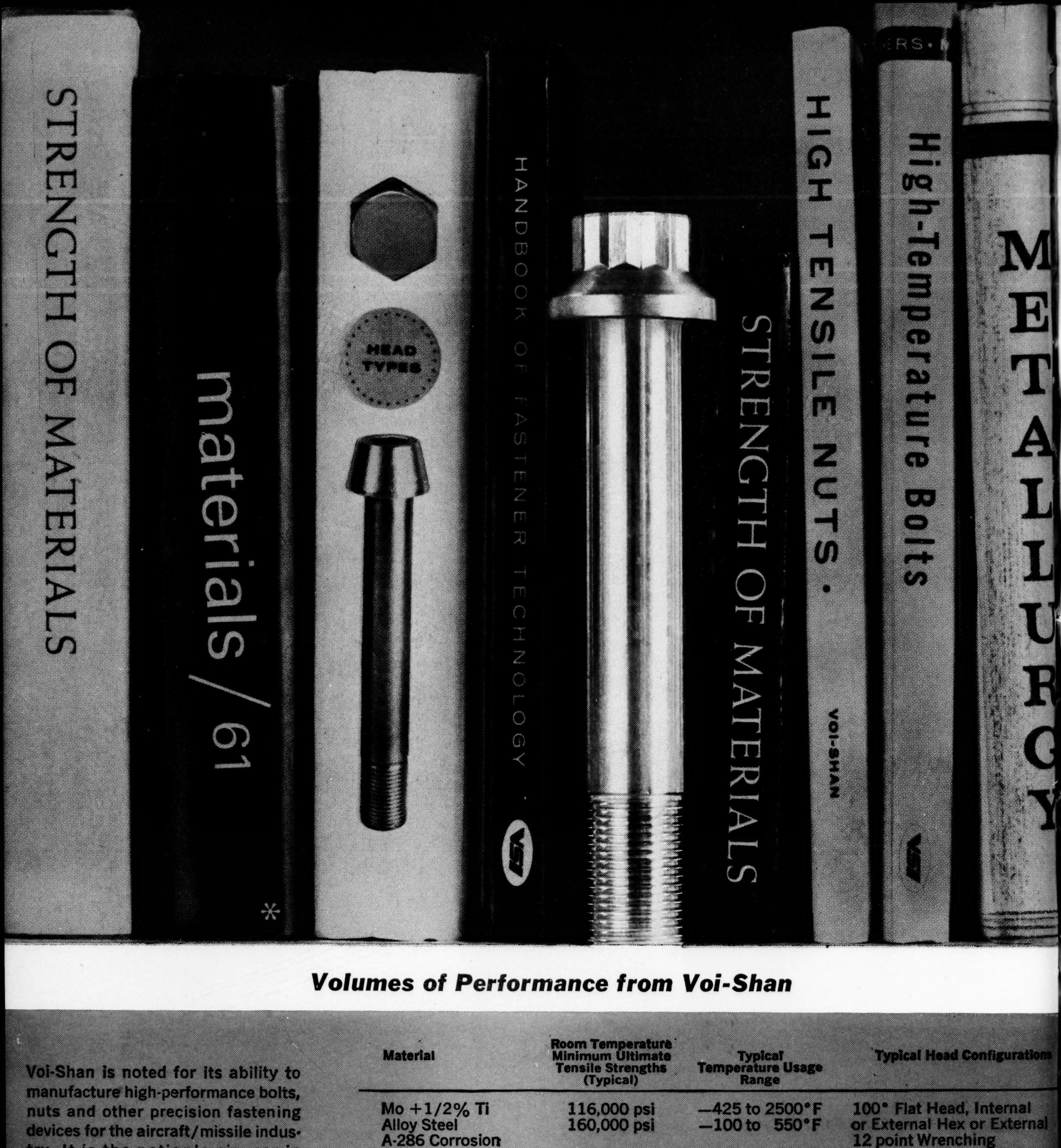

Volumes of Performance from Voi-Shan

Voi-Shan is noted for its ability to manufacture high-performance bolts, nuts and other precision fastening devices for the aircraft/missile industry. It is the nation's pioneer in Titanium bolt manufacturing and has worked with such exotic materials as Beryllium, Zirconium, and Columbium. Other exotic materials such as Tantalum and Tungsten are constantly being experimented with for their potential use as high-performance fasteners.

The table shown, is representative of Voi-Shan's range of experience in the manufacture of high-strength and high-temperature bolts. Write for descriptive literature on these and other Voi-Shan quality products.

Material	Room Temperature Minimum Ultimate Tensile Strengths (Typical)	Typical Temperature Usage Range	Typical Head Configurations
Mo +1/2% Ti	116,000 psi	—425 to 2500°F	100° Flat Head, Internal or External Hex or External 12 point Wrenching
Alloy Steel	160,000 psi	—100 to 550°F	
A-286 Corrosion Resistant Steel	160,000 psi	—425 to 1200°F	
Inconel X	165,000 psi	—425 to 1400°F	
M-252	170,000 psi	—425 to 1400°F	Threads: MIL-S-7742 (Class 3A)
Alloy Steel	180,000 psi	—100 to 550°F	100° Flat Head, Internal or External Hex or External 12 point Wrenching
René 41	180,000 psi	—425 to 1600°F	
K-Monel	180,000 psi	—425 to 1000°F	
Waspaloy	180,000 psi	—425 to 1400°F	
Udimet 500	195,000 psi	—425 to 1600°F	
A-286 Corrosion Resistant Steel	200,000 psi	—425 to 1200°F	Threads: MIL-S-7742 MIL-S-8879 (Class 3A)
PH 15-7 Mo	220,000 psi	—300 to 1000°F	Internal or External Hex or External 12 point Wrenching
Hy-Tuf	220,000 psi	—100 to 550°F	
Various	220,000 psi	—100 to 900°F	Threads: MIL-S-8879 (Class 3A)
5% Chrome	260,000 psi	—100 to 900°F	
Die Steels	280,000 psi	—100 to 900°F	

VOI-SHAN MANUFACTURING COMPANY

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AEROSPACE CALENDAR

Dec. 29-31—Eighth King Orange International Model Plane Meet, Miami, Fla.

Jan. 8-12—1962 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 16-18—Eighth Annual National Meeting, American Astronautical Society, Sheraton-Park Hotel, Washington, D. C.

Jan. 21-24—Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Jan. 29-Feb. 2—American Institute of Electrical Engineers' Winter General Meeting, Hotel Statler and Coliseum, New York, N. Y.

(*Continued on page 6*)

AVIATION WEEK and Space Technology

December 18, 1961

Vol. 75, No. 25

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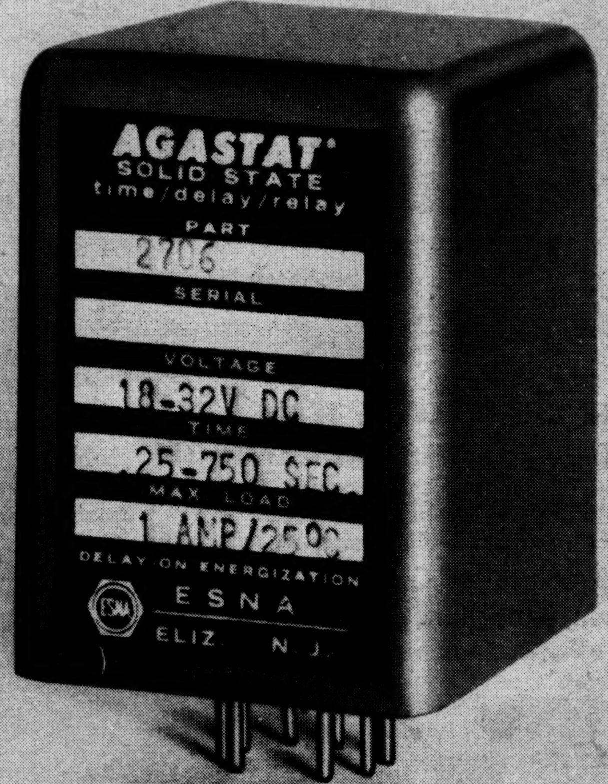

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AEROSPACE CALENDAR

(*Continued from page 5*)

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Range Reconnaissance and Tracking of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Flight Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston, Mass. Sponsor: AF Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Meeting, Institute of the Aerospace Sciences, Salt Lake City, Utah.

December 18, 1961

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▶ McDonnell to build 12 two-man capsules and modify four Mercury spacecraft for flights of 18 orbits.

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▶ National-Continental proposal will test whether—or to what extent—Board will foster realignments.

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▶ Study contract aimed at providing multi-purpose vehicle by 1966; size expected to be small.

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PICTURE CREDITS

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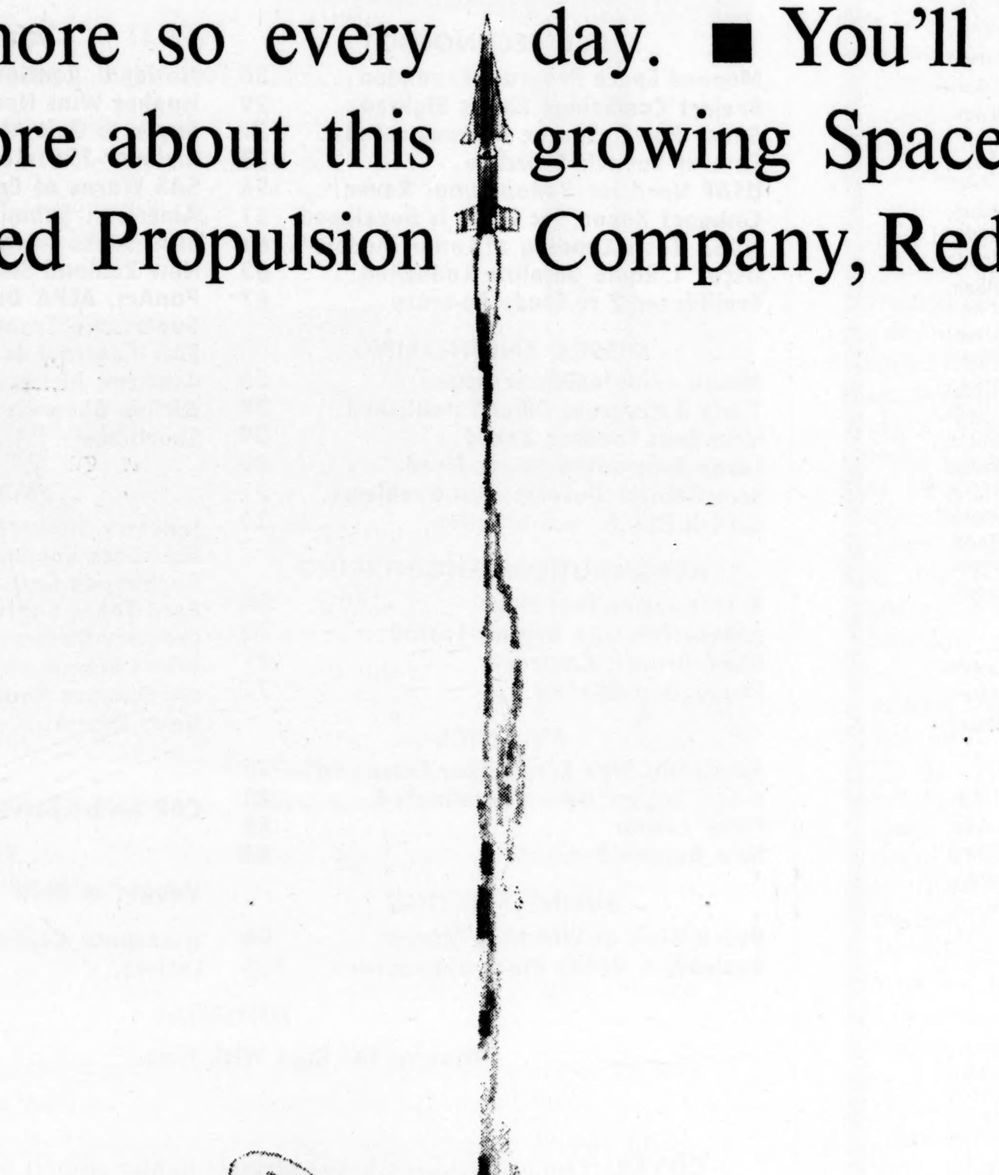

EDITORIAL

Winning the Race With Time

(As chief of the USAF Systems Command, Gen. Bernard A. Schriever has a unique responsibility for both technical and management phases of new weapon systems. His thoughts on the management phase of this endeavor deserve wider dissemination in the aerospace industry than the relatively small audience that heard them originally at the Aircraft Luncheon Club in Washington, D. C. AVIATION WEEK *is therefore presenting significant excerpts from his speech dealing with the management problem. —RBH)*

The most pressing problem we face in the Air Force today, is the problem of winning the race with time.

As Commander of the Air Force Systems Command, I am concerned with the timely acquisition of new aerospace systems. This is a problem of management, for our responsibility is to balance the requirements of quality, cost, and time, in order to insure that the Air Force not only gets the systems it needs, but that it gets them on time.

This is not a problem that can be solved by us alone. The task of systems acquisition, which is the primary job of the armed services today, is a wide-ranging one. It calls for the highest degree of cooperation between the military, industrial, and scientific communities. And it needs strong public backing.

The challenge confronting us as a nation is an urgent one. ... The contest between tyranny and freedom is not new. It is as old as history. But today the forces of tyranny are organized as never before. The dictatorship that confronts us today is the most powerful, ruthless, and extensive that has ever been in being. Its fanatic drive toward world domination poses a continual threat to free men everywhere.

This means that we as a nation must gird ourselves for a long contest with a relentless adversary. To wage this contest successfully we must not only be strong; we must also be patient. Adequate military strength—now and in the years to come—is our best guarantee against armed aggression. It is basic to our national policy, because it permits the decisive conflict of ideas to be carried on without resort to war.

The Soviets today have decided to make a determined single-minded effort to attain military superiority through the use of science and technology.

The Soviet emphasis on military technology has placed our nation in an intensive and serious technological competition. It is a contest that we dare not lose.

We will not win this contest if we try to convince ourselves that we can carry on "business as usual." On the other hand, we will not win it through a series of frantic "crash" programs. We no longer have the problem, as we did in the Second World War, of meeting a relatively short-term threat. Instead, we must prepare for a period of intensive effort that may last for the rest of this century.

To put it in other terms, we are neither taking a leisurely walk in the countryside nor sprinting in the 100-yard dash. We are in a different kind of race—a marathon race. This is a contest that demands not only speed, but also patience, determination, and endurance.

The pacing factor in this contest is not technology. It is management. I became convinced of this during my experience in the ballistic missile program, and since then I have encouraged the wider application of the management principles we learned at that time.

But the challenge we face today is far greater than the challenge we met in producing the ICBM. Our task has drastically increased in both size and complexity. Moreover, the advent of the space age is extending the area and scope of operations that can be used by a potential enemy. All of these factors demand that we gear our management to the long-range task of providing the systems we need for defense. . . .

Our goal is to make advances in management techniques concurrently with advances in weapon technology. Only in this way can we insure the most rapid and efficient translation of technology into operable weapon systems. . . .

We are taking greater interest in source selection and in the control of subcontracts. In this connection, quality control and reliability are major areas of concern. In an age when a faulty transistor or valve can cause a costly missile failure, the problem of quality control assumes major importance. As we move out into the environment of space, where hard vacuum, radiation, and temperature extremes are encountered, new standards of reliability are critical.

One of the keys to effective management is information, and for this reason we are developing a number of techniques for obtaining, processing, and displaying information rapidly.

Our present Presto reporting system makes use of rapid communications equipment to provide individual reports on weapon system status, daily reports on missile test activity, daily satellite reports, and a summary of problems and anticipated problems on designated systems.

In the field, we have automated reporting systems such as Champion, a system for ballistic missile hardware management, and Cram, a control system for following all procurement actions and paperwork from issuance of a purchase request to completion of a contract.

It is not enough merely to acquire information. We must also be able to use it for purposes of prediction and control. For instance, what are the cost implications if a program is accelerated, stretched-out, or canceled? What will be the difference in time of delivery if the rate or amount of expenditure is reduced or increased? What are the implications in terms of time and cost if the objectives or end products of a program are changed?

If we are to manage effectively, we need to have at least "ball park" answers to these questions. At present we are working on a new programing and control system that uses computers to obtain "order of magnitude" answers in situations involving alternative decisions, and to detect real or potential deviation from planned programs in time to make adjustments.

All of these techniques will enable us to manage more effectively, which is another way of saying that they will help us win the race with time. But improved techniques alone will not solve our management problems. We need people who will make them work. The essential factor in any program is the participation of dedicated people who know their jobs and are committed to getting them done.

Along with the many refinements in our methods of management, we need a renewed dedication to the tasks ahead of us. For the pressures of time are likely to grow greater, not less, and the Communist drive toward world domination shows no sign of slackening. We are in for a prolonged and severe test of the democratic system and its ability to cope with the problems of a complex and changing world.

BURGOYNE IGNORES RECONNAISSANCE AND INVITES DISASTER

General "Gentleman" John Burgoyne was not one to fret over reconnaissance.

Saratoga, frequently called the turning point of the American Revolution, was the end product of a series of "no reconnaissance" battles fatal to Burgoyne's invasion force. Supremely confident as he swung southward from Canada, the British commander rarely knew where or what was ahead. St. Leger's British force, vital element in Burgoyne's campaign, disintegrated when its sizable Indian contingent vanished at news of a huge American counter force. Reconnaissance would have readily shown the Americans mustered a mere 1,000 men. Along his march, Burgoyne dispatched his grenadiers to reinforce a Hessian advance unit at Bennington . . . as usual, without adequate reconnaissance. The grenadiers did not discover until after they were decimated by a Colonial force that the Hessians had already been wiped out. Finally, Burgoyne's confused and weakened men, alone and completely ignorant of enemy forces, surrendered at Saratoga.

Throughout the history of warfare, successful field commanders have based command decisions on proper reconnaissance. Burgoyne ignored history and the obvious need for strategic and battlefield reconnaissance thus committing a series of faulty command decisions and helping to assure the success of the American Revolution.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

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WHO'S WHERE

In the Front Office

Gen. Thomas Dresser White (USAF, ret.), elected a director of Eastern Air Lines, Inc., and **Thomas E. Creighton**, executive vice president-finance. Mr. Creighton continues as Eastern's secretary; **Carl A. Wallen** succeeds him as treasurer.

F. W. Godsey, Jr., retired president of Electronic Communications, Inc., has joined the National Aeronautics and Space Administration as consultant.

Dr. Elmer W. Engstrom, elected president of Radio Corporation of America, New York, N. Y., succeeding **John L. Burns**, resigned. Also: **Arthur L. Malcarney**, executive vice president of RCA Defense Electronic Products, elected a director.

Robert E. Steinman, president and a director, Gaertner Scientific Corp., Chicago, Ill., succeeding the late Dr. S. Jacobsohn.

Alfred di Scipio, president and chief executive officer of the newly formed Information Systems Division of International Telephone and Telegraph Corp., New York, N. Y.

Dr. Joseph A. Boyd will become vice president and assistant to the president of Radiation, Inc., Melbourne, Fla., in January. Dr. Boyd is now the Director of the Institute of Science & Technology at the University of Michigan.

B. Allison Gillies, a director, Flexible Tubing Corp., Guilford, Conn. Mr. Gillies is a partner and West Coast representative of Jones & Gillies, Washington, D. C.

Max W. Hunter will join the National Aeronautics and Space Council of the U. S. on Jan. 1. **Theodore D. Smith** will succeed Hunter as chief engineer-space systems, Missile and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Honors and Elections

L. Eugene Root, president of Lockheed Missiles & Space Co., has been elected president of the Institute of the Aerospace Sciences for 1962.

Vice Adm. Robert B. Pirie, Deputy Chief of Naval Operations for Air, has been awarded the Frank M. Hawks Memorial Award by Air Service Post 501.

Edward V. Appleton, principal and vice chancellor of the University of Edinburgh, Edinburgh, Scotland, had been named the recipient of the Institute of Radio Engineers' 1962 Medal of Honor "for his distinguished pioneer work in investigating the ionosphere by means of radio waves."

George R. Galipeau, vice president of Van Dusen Aircraft Supplies, Inc., has been elected president of the Aviation Distributors and Manufacturers Assn. Elected vice presidents: **H. Webster Crum** of Lycoming Division of Avco Corp., and **Roy Backman** of Pacific Airmotive Corp.

Nathan R. Rosengarten, deputy director for engineering, GAM-87 Systems Project Office, Aeronautical Systems Division, Wright-Patterson AFB, has received a Citation of Honor from Drexel Institute of Technology for "pioneering work in jet propulsion and contributions to national defense in the field of aeronautics."

(*Continued on page 109*)

INDUSTRY OBSERVER

▶ British cabinet and top officers of the Royal Air Force, Army and Navy are developing a five-year projection of the United Kingdom's defense posture for a White Paper scheduled for review early next year. One area of investigation is an Admiralty study of what it defines as a Polaris-type missile for nuclear submarines.

▶ First Convair 990 with modifications aimed at boosting top speed by at least 20 kt. to meet its guarantee flew last week. Modifications include a new wing leading edge and fairings on the engine pods.

▶ New technique for detecting nuclear explosions which is based on the geomagnetic disturbances that result has been proposed to Army Signal Corps by Allied Research Associates, Inc., of Boston. Army Signal Research and Development Agency is expected to fund an initial study of the propagation of hydromagnetic waves in the lower portion of the ionosphere.

▶ First production set of infrared surveillance equipment designed for Grumman's AO-1CF surveillance version of the Mohawk has been installed on a prototype aircraft, but Army's evaluation has been delayed by a shortage of support equipment and probably will not begin before January. Grumman, which will build 17 AO-1CFs for Army, plans to install a variety of sensory devices but the company says weight and bulk of this equipment must be reduced before one aircraft can perform a multiplicity of functions.

▶ Navy helicopters used for Mercury capsule recovery now are equipped with flotation bags to avoid loss of the capsule in case it fills with water. Three-foot dia. rubberized bag is hooked to capsule's lifting bale along with the lift cable. Bags were carried for the recent MA-5 flight (AW Dec. 4, p. 27) but were not needed because recovery was made by a destroyer.

▶ Technique for continuously monitoring condition of solid-propellant rocket motors without removing them from launch or storage position, by using a thin-film corrosion detector to spot deterioration, is being sought by Air Force Flight Test Center. Companies with competence in the technique will be asked to bid on a feasibility study.

▶ NASA headquarters is expected to reach a decision soon on the proposed Surveyor B program, which calls for a lunar orbiter that would take precision photographs of the lunar surface in direct support of the Apollo manned lunar landing program. Jet Propulsion Laboratory recently completed a preliminary development plan. Original Surveyor program calls for soft-landing of instruments on the moon.

▶ Army's ultimate light observation helicopter (LOH) is expected to incorporate a mixture of design details and components developed by Bell, Hiller and Hughes, the three firms selected to produce five rotorcraft each for user testing. Final LOH configuration will become operational in 1965 rather than 1964, as originally planned. Delay reflects a decision to await the buildup of an inventory of supplies.

▶ North American Aviation has invited a large number of potential subcontractors to its Downey, Calif., plant to discuss the Apollo project (AW Dec. 4, p. 26). Briefing dates for interested firms are being scheduled now.

▶ Strategic Air Command is considering abandoning or altering its annual combat competition (AW Oct. 9, p. 91) and has asked subordinate units for recommendations. Possible alternative would be competition only through the numbered Air Force level, with bombers and tankers staging from their home bases. For the past two years, crews selected in numbered Air Force eliminations have been sent on temporary duty to a single SAC base to compete for over-all championships in bombing, navigation and air refueling.

▶ Snecma has proposed use of the Atar turbojet engine for the Indian Mach 2 Hindustan-24 fighter. The Atar 9 powers the Mirage 3 and 4. Indian Defense Ministry wants full manufacturing rights to whichever engine it buys. Russia already has offered such rights for engines it has proposed. India's choice still is believed to be three months away.

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Washington Roundup

Missile Budget Shifts

President Kennedy last week approved the Defense Department's request for approximately $51 billion for Fiscal 1963. Last minute changes included elimination of funds for mobile Minuteman (see p. 26). Official explanation is that technical and operational problems were too great. The missile would have required development of a new guidance system. Defense Department will rely instead on a balance of fixed Minuteman in silos and mobile submarine-launched Polaris missiles.

Money for the new solid-propellant medium range ballistic missile (MRBM) totals about $120 million through Fiscal 1963. But initiation of development has been delayed by Navy's request that it include the capability of being seaborne. Also still very much unresolved is the question of control over nuclear warheads, since the missile will be deployed chiefly by NATO nations.

Secrecy was ordered for the recent movement of more than 30 Vertol H-21C helicopters, more than six North American T-28 trainers and 400 Army pilots and support troops by converted jeep aircraft carrier to South Viet Nam. But the ship had to thread its way 45 mi. up the Saigon River with its deckload of helicopters and aircraft visible to thousands of residents.

Partridge Report

Report prepared by retired USAF Gen. Earle E. Partridge went beyond his original charter of studying a national command and control system. The report is now being reviewed by the staff of the Joint Chiefs of Staff. Current thinking is that the Partridge recommendation for a single operational military commander would have to be supplemented by a military deputy for the unified operational commands and another for the unified logistic and support agencies.

Meanwhile, Air Force is having second thoughts about the single service it has sometimes advocated—probably because it is not as clearly the dominant service as it was when Strategic Air Command was unchallenged as the strategic striking power of the U. S. Some top USAF officials now are agreeing that there are advantages to the nation in individual service identity. A single chief of staff is still favored, however. Navy is sticking firmly to its position that the Joint Chiefs of Staff system is best and Army is lukewarm to any change.

Burton P. Brown has been named assistant director of defense research and engineering for air defense. He was manager of missile detection systems development for General Electric's Heavy Military Electronics Department.

Foreign Carrier Permits

No strong case in support of domestic airlines, which favor capacity restrictions on foreign carriers serving the U.S., has developed so far in hearings before Civil Aeronautics Board Examiner Edward Stodola on the terms, conditions and limitations of foreign air carrier permits. Testimony has revealed that a number of foreign governments are restricting capacity of U. S. lines, but they are in a minority. At one point consideration was given to requesting an end to the investigation for lack of evidence. Foreign carriers were disappointed that State Department deferred stating its position until the case goes to the full board. They felt State would take the stand that capacity restrictions violate bilateral agreements between the U. S. and other countries.

Civil defense funds in the Fiscal 1963 Defense Department budget will be $700 million. Of this, $400 to $500 million will go for community and institutional fallout shelters. Defense has surveyed shelter areas capable of holding 50 million people, will survey enough to hold another 20 million in the next fiscal year.

Retrograde Satellite

Retrograde satellite discovered recently in an east-to-west orbit around the earth has turned out to be Russia's Lunik 3, which the U. S. thought had burned in the earth's atmosphere in April of 1960 after photographing the backside of the moon. Astronomers have photographed it and an effort is under way to prepare orbital tables.

Italy, Brazil and Canada have been briefed by National Aeronautics and Space Administration on how they might take part in experiments with American Telephone & Telegraph's Telstar communications satellite next April or May. Great Britain, France and West Germany, who already have agreed to take part, also were briefed and a number of other countries have shown intense interest, NASA says.

The doors also are open for Russian participation and State Department will welcome discussions. But so far the Soviets have not indicated any interest.

NASA has informally told Defense Department it is receptive to any research and development requirements Defense might want to add to the two-man Mercury program (see p. 26).

Fred Korth, new secretary of the Navy, has another accomplishment besides law, banking and his previous service in uniform with the Air Transport Command and in mufti with the Army (see p. 34). He is vice commander of the Ft. Worth squadron of the Air Force Assn.

—Washington Staff

Manned Space Flight Program Expanded

McDonnell to build 12 two-man capsules and modify four Mercury spacecraft for flights of 18 orbits.

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration is moving quickly to its advanced manned space flight program with tight production and flight schedules calling for extended one-man earth-orbiting missions within a year and two-man missions in two years.

Final NASA approval has been given for two new concepts to fill the gap between the completion of three-orbit Project Mercury flights and the start of Project Apollo qualification missions. The approved interim program, under consideration for the past six months, consists of the following:

- **Modification of four** standard-sized Mercury capsules for 18-orbit manned missions, the first of which has been scheduled for late next year.
- **Construction of 12** two-man spacecraft, which will be Mercury configurations 14% larger in all dimensions than the existing capsule (see drawing). Flights will start in 1963. Although this program has a variety of objectives, it is being designed primarily to develop and proof test the rendezvous technique which NASA hopes to use for Apollo lunar landing missions (AW Nov. 6, p. 26).

McDonnell Aircraft Co., prime contractor for the existing capsule, received about $500,000 for studies and detailed design work on both vehicles. The company will receive a $3.5-million contract to modify four production capsules for 18-orbit flights, and a new contract to build 12 two-man spacecraft.

Total Cost $500 Million

NASA and McDonnell are now negotiating the two-man capsule contract, which has an estimated value of $200 million. The agency expects to spend another $300 million for vehicles—the Martin Titan 2 launcher, and the General Dynamics-Lockheed Atlas-Agena.

In its rendezvous development program, NASA will use a modified Agena B stage as a target, and the two-man spacecraft as the chaser. First flights will be capsule system tests, and rendezvous missions will follow.

The two-man spacecraft program has been called Mercury Mark 2, but this designation has been rejected and a new name will be selected. The program will give the U.S. its first operational spacecraft, with vast potential for both scientific and military uses.

The NASA program has tactical objectives similar to the Air Force Saint (satellite interceptor) program, in that the Agena stage and the rendezvous technique are involved in both (AW Nov. 14, 1960, p. 26). The initial Saint vehicles will be unmanned.

In addition to developing and proving rendezvous, the two-man capsule will be used as a test bed for components to be used in Apollo and other advanced programs. George M. Low, director of Spacecraft and Flight Missions in NASA's Manned Space Flight Office, said access doors in the outer structure will allow rearrangement of subsystems in modular-type schemes, eliminating the need to take the spacecraft apart.

Low said that the pressure vessel serving as the pilot compartment in the larger vehicle will be configured as a rectangle, with subsystems for the most part installed outside the compartment. The standard Mercury capsule has most subsystems installed inside the pressure vessel, and they are highly inaccessible. It took technicians 14 days to repair a leak in the capsule reaction jet feed line prior to the Mercury-Atlas 5 flight (AW Nov. 20, p. 35) because it could not be fixed on the launch pad.

Most two-man spacecraft components will be larger versions of existing Mercury components. This means, Low said, that when Apollo hardware is ready for test, it can be substituted piece-by-piece without going into a major redesign.

Decision to go ahead with the larger Mercury capsule means NASA can move ahead quickly with major fabrication. In most cases, the Mercury wind tunnel and scale model launch data will be applied to the two-man vehicle design, and extensive research testing will not be required. Firm decisions have not been reached on several of the major subsystems, including pilot escape and recovery.

Low said the two man capsule probably will incorporate ejection seats, so that an escape tower similar to that in the Mercury system could be eliminated. Use of storable propellants in the launch vehicle is expected to reduce the likelihood of an abort during launch.

If the Rogallo-type wing now under study can be translated into hardware,

Mobile Minuteman Is Canceled

Washington—Defense Department last week canceled the mobile Minuteman intercontinental ballistic missile program, which would have deployed the solid propellant weapons in railroad cars, and ordered the total of silo-launched Minuteman missiles increased to 900.

Of an initial funding of $108 million in the Fiscal 1960 budget, about $100 million has been spent on mobile Minuteman. Further development was postponed last March by the Kennedy Administration. Steps are now being taken to cancel all mobile Minuteman contracts.

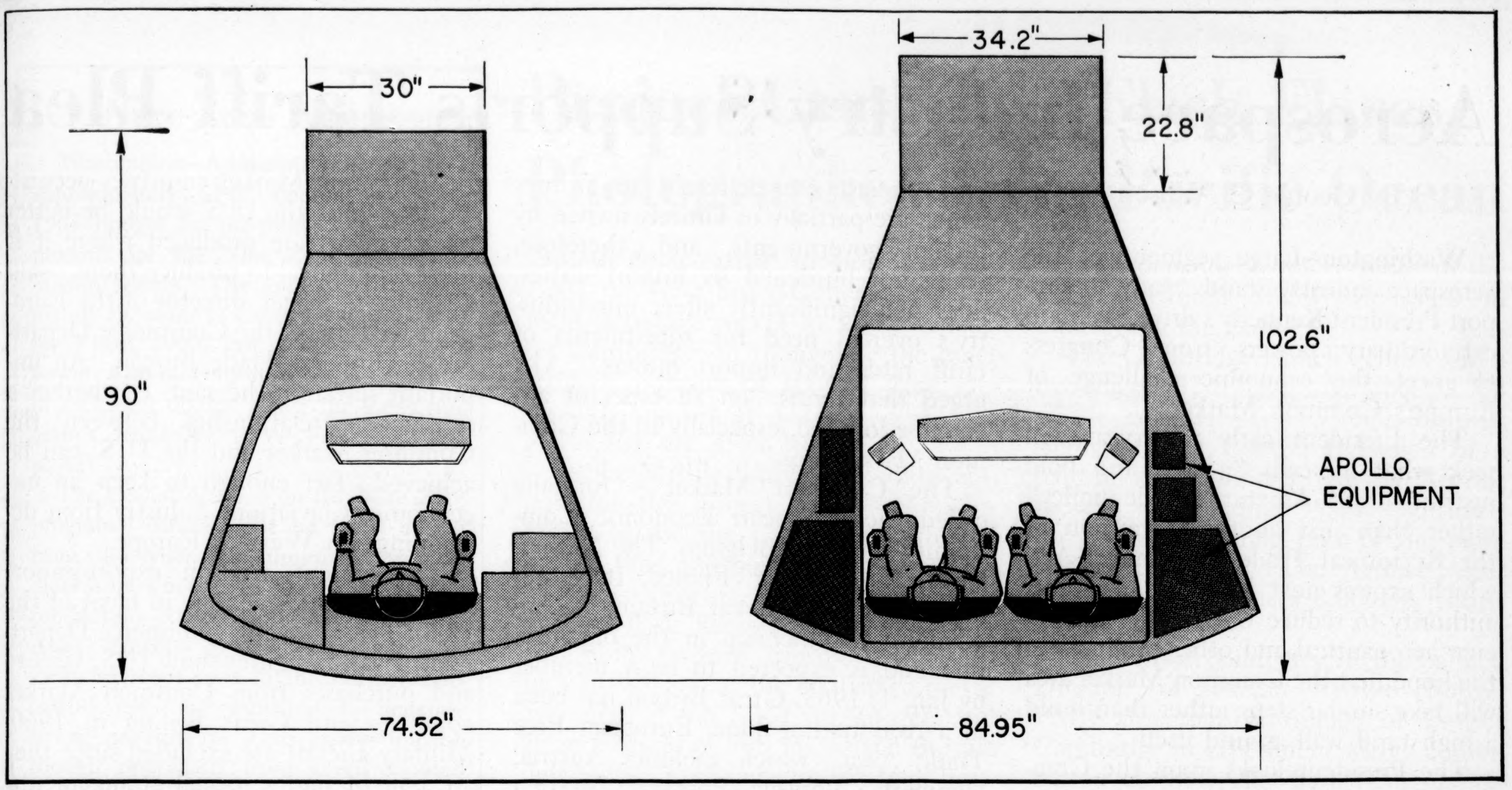
Previous goal for fixed Minuteman missiles was 600, of which about 300 were in the manufacturing process. As a result of the increased emphasis, the Air Force has instructed the prime contractor, The Boeing Co., to start procurement actions to produce 600 more. Obligations for this production would not be made until Fiscal 1963. Budget request for fixed Minuteman in that fiscal year is $2.1 billion (AW Dec. 11, p. 26).

As proposed by the Air Force last summer, the program package for mobile Minuteman would have included $200 million for Fiscal 1962, $270 million in 1963, $585 million in 1964, $945 million in 1965, $645 million in 1966 and $264 million in 1967.

The proposed fixed Minuteman program package was $1.3 billion in Fiscal 1962, $2.1 billion in 1963, $2.6 billion in 1964, $2.8 billion in 1965, $1.9 billion in 1966 and $1.5 billion in 1967. This program would have accounted for 2,500 missiles.

As of late last week there had been five attempted development firings of the fixed Minuteman over the Atlantic Missile Range from Cape Canaveral. The first shot from a launching pad Feb. 1 was successful. The second missile shot from a pad May 19 was destroyed by the range officer when the second stage malfunctioned, although the first stage burned successfully. A July 27 shot from a pad was successful except in range accuracy.

The first attempt at firing from a silo was made Aug. 30. The first stage fired successfully and the missile rose from the silo, shortly after which the second stage ignited prematurely and exploded. A silo shot Nov. 17 was successful.



DIMENSIONS of advanced Mercury capsule will be 14% greater than those of current model. Area between manned pressure vessel and capsule structure will be used to test Apollo and other advanced program components during extended two-man orbital flights. Most of current Mercury capsule's components are crowded into pilot's compartment.

Low said, the two-man capsule will use it. The steerable device is also called flexwing and parawing, and North American Aviation has a Phase 2 study contract for this recovery system. NASA also is funding Radioplane Div. studies of its glide-sail concept, in which a flap is used to guide a parachute in recovery.

The two crewmen will be side-by-side in the spacecraft. Pilots for the initial flights will be selected from among the seven-man Mercury astronaut team, and Low said supplementing this pool presents no problem. Additional crewmen may come from the X-15 USAF and NASA pilot pool, or from the pilots being trained for the USAF Dyna-Soar program.

Astronauts in both two-man spacecraft and Apollo crews will be aircraft pilots, Low said, because there is a large number of scientific and medical specialties available among those with flight experience.

For some missions, the two-man capsule will carry along the adapter section—the same technique that will be used to extend the mission time of the existing Mercury capsule to 18 orbits. In order to keep the weight within the Atlas launch vehicle limitation, the modification involves removal of the periscope and backup telemetry systems, and installation of oxygen and power supplies in the Atlas-Mercury adapter section.

Instead of remaining with the launch vehicle at separation, the adapter will be part of the orbiting spacecraft and will be jettisoned just prior to earth atmosphere re-entry.

The adapter section will house propellants for mid-course and orbital correction maneuvers in the two-man capsule in some missions. Initially, the on-board propellant will be hydrogen-peroxide—the same used for attitude correction in the present Mercury system. Later versions will use a throttleable engine and hypergolic propellants. Hypergolic propellants also will be used in the Apollo system.

Decision to proceed with the $500 million two-man spacecraft in a rendezvous development program could be viewed as the first official confirmation that NASA favors the rendezvous approach over direct flight to the moon for Project Apollo. Even stronger indications appeared in a talk made in New Orleans Dec. 11 by Dr. Robert C. Seamans, Jr., associate NASA administrator.

After explaining the manned space flight program, Dr. Seamans said: “To provide insurance in case we are not able to perfect the rendezvous technique in time to meet our schedule, we have decided to begin development of the Nova launching vehicle as well. We shall bring it along so that it will be available if required for the manned lunar landing and for the more ambitious missions into space that will follow the landing on the moon.”

Saturn C-4 Engine

Washington—Use of a single 200,000-lb. thrust J-2 engine to power the third stage of the Saturn C-4 launch vehicle is under consideration by the National Aeronautics and Space Administration. The stage would be called S-4B.

The C-4 vehicle will be a four-barrel cluster of Rocketdyne F-1 engines as booster, and a cluster of four Rocketdyne J-2 engines in the second stage. The C-4 is seen as the primary launch vehicle for rendezvous missions in the Apollo manned lunar landing program (AW Nov. 6, p. 26).

Selection of the two interim manned spacecraft has resulted in cancellation of plans to fit standard Mercury vehicles with life support equipment to sustain two monkeys and a chimpanzee on flights of up to 14 days.

Instead, NASA plans to increase manned flights to and beyond two weeks and eliminate the need for animal missions.

The two-man spacecraft project will be managed by NASA's Manned Spacecraft Center, with John Chamberlain as project chief. Chamberlain's group is at Langley Field, but will go to Houston, Tex., shortly. Although the center's management structure has not been defined, it is expected that it will include two small project offices—one for Apollo and the other for the two-man vehicle.

The Martin Titan 2 launch vehicle has a capability of placing a 6,000-lb. payload into a 300-mi. orbit. The two-stage vehicle was scheduled to have its preliminary flight rating test (PFRT) late last week at Martin's Denver facility. First flight is to be made in January or February from the Atlantic Missile Range.

Aerojet-General Corp. builds the engines for the Titan 2 vehicle. They are fueled by a storable hypergolic mixture of 50% hydrazine and 50% unsymmetrical dimethylhydrazine. Oxidizer is nitrogen tetroxide.

Aerospace Industry Supports Tariff Plea

By George C. Wilson

Washington—Large segment of the aerospace industry stands ready to support President Kennedy's drive to obtain extraordinary powers from Congress to meet the economic challenge of Europe's Common Market.

The President early next year will seek what he calls "a new and bold instrument of American trade policy" rather than just another extension of the Reciprocal Trade Agreements Act, which expires next June 30. He wants authority to reduce U. S. duties on foreign aeronautical and other products in the hope that the Common Market area will take similar steps rather than build a high tariff wall around itself.

The President looks upon the Common Market as "an historic meeting of need and opportunity. If, however, the U. S. is to enjoy this opportunity it must have the means to persuade the Common Market to reduce external tariffs to a level which permits our products to enter on a truly competitive basis," he said.

Although the legislation is still in the drafting stage, President Kennedy is expected to ask Congress for a five-year trade law that would give him authority to lower U. S. tariffs by as much as 50% and eliminate duties altogether on some products.

The 1958 act gave him authority to reduce tariffs by as much as 20% over a four-year period. Right now the U. S. imposes a duty of 12.5% on aircraft and aeronautical products coming into this country from the free world. Duty is 30% for such products coming from Communist countries.

The Aerospace Industries Assn. has supported the Common Market's formation and is now encouraging the U. S. government to achieve a close affiliation with the area. "We've got to go in there even if it hurts," I. H. Taylor, AIA export director, told AVIATION WEEK. "We've encouraged the whole Common Market in the past and now we've got to have a close association with it on the best basis we can get." Taylor said AIA believes the ideal arrangement would provide for identical tariffs on aeronautical products in the U. S. and the Common Market.

AIA is especially anxious to increase the export of helicopters and light and medium weight aircraft. The association, in a formal statement filed with U. S. officials now negotiating reciprocal trade agreements, said "exports of these utility airplanes to West Europe have been insignificant due to high tariffs and rather complex import restrictions. The fact that some of the larger transport aircraft are delivered to airlines which are partially or entirely owned by foreign governments, and, therefore, really not burdened by import duties, does not significantly affect our industry's over-all need for adjustments of tariff rates and import quotas." AIA urged that tariffs "on all types of aircraft be lowered, especially in the Common Market area."

The Common Market – formally called the European Economic Community—includes Belgium, The Netherlands, Luxembourg, France, Italy and West Germany. Great Britain has applied for membership in the organization and is expected to be a member by Jan. 1, 1963. Great Britain has been in a rival trading bloc, European Free Trade Assn., which includes Austria, Denmark, Norway, Portugal, Sweden and Switzerland. These countries are expected to follow Great Britain's lead and join the Common Market.

Present Duties

Within the existing Common Market, duties imposed on aircraft imported from the U.S. range from 3.4% to 19%, depending on the country and the weight of the aircraft. But the Common Market agreement calls for uniform tariffs ranging from 12 to 15% to take effect once the market is fully operational, probably about 1970. But in the meantime, the Common Market countries plan to suspend some of these tariffs and reduce others.

As things stand now, Commerce Department specialists see the Common Market as a boon to the U. S. aerospace industry rather than a threat. They contend the U. S., because of its advanced technology, can continue to compete successfully and will increase its sales to the European market if tariffs are reduced and the predicted prosperity of the Common Market countries occurs.

"We think the U. S. would be better off if aircraft are produced where it is most economical to produce them," said Clarence S. Siegel, director of the European Division of the Commerce Department's Foreign Trade Bureau. An important question, he said, is whether a satisfactory relationship between the Common Market and the U. S. can be achieved "fast enough to keep an uneconomical [aviation] industry from developing" in Western Europe.

The current aviation export-import balance is tipped sharply in favor of the U. S. The following Commerce Department aviation figures show U. S. sales to and purchases from Common Market countries and Great Britain in 1960. Military aircraft are excluded since they are bought under special arrangements.

	U. S. Exports	U. S. Imports
	(In Thousands)	
Belgium, Luxembourg...	$ 21,700	$ 6
Netherlands	57,100	25
France	95,500	804
West Germany	30,900	104
Italy	17,600	18
Great Britain	87,900	27,456
Total	$310,700	$28,413

France's aeronautical exports to the U. S. totaled $24,143,000 for the first nine months of 1961, largely because of the sales of Sud Aviation Caravelles.

In addition to seeking broad tariff powers, President Kennedy will renew his efforts to eliminate some of the tax concessions enjoyed by U. S. industries which locate plants in Western Europe. A revampment of depreciation rules also is underway by the Treasury Department (AW Dec. 11, p. 37).

Industry's responsibilities in maintaining a vigorous U. S. economy are, President Kennedy said: "be competitive, through lower costs and prices and better products and productivity; and be export-minded."

"If American businessmen cannot increase or even maintain their exports to the Common Market," the President said, "they will surely step up their investments in new American-owned plants behind those tariff walls so they can compete on an equal basis, thereby taking capital away from us as well as jobs from our shores and worsening still further our balance of payments position.

President Kennedy's request for increased tariff authority will be considered first by the House Ways and Means Committee and then by the Senate Finance Committee. Lobbying already is intense on both sides, with Administration supporters pitted against protectionists who argue that further tariff reductions will lead to more U. S. unemployment.

Titan 3 Office

Titan 3 program office has been established at Aerospace Corp., and will be headed by Dr. D. A. Dooley, who has been director of spacecraft sciences in the company's Systems Research and Planning Division. His new title will be group leader for space launching systems.

The work statement for the project has been completed by Aerospace, and is being held pending approval by the Defense Department. Aerospace's Dyna-Soar booster program office, which dealt with use of Titan 2, probably will be dissolved and it is likely that Titan 3 may become the launcher for the Dyna-Soar glider.

Nike Zeus Funds

Washington—Administration will seek approximately $140 million in Fiscal 1963 budget for pre-production of components for the Nike Zeus anti-ICBM missile system. The amount is approximately the same as Congress appropriated for Fiscal 1960, but which the Eisenhower Administration withheld because of technical doubts about the Zeus program's feasibility (AW Feb. 8, 1960, p. 32).

The crucial decision on the Nike Zeus program's future must be faced a year from now when the Administration must determine whether to request a full-scale production commitment. By then, the Army expects to have completed its Zeus intercept tests in the Pacific. Successful tests are expected to generate strong pressure for Zeus production, although opponents have never doubted its ability to destroy a single warhead but have questioned its ability to discriminate between warheads and decoys and Zeus' vulnerability to saturation attacks.

Most serious competitor to Zeus will be the Advanced Research Project Agency's Arpat (ARPA-Terminal) defense concept currently under study by Raytheon, Lincoln Laboratory and other supporting contractors.

The Ballistic Missile Boost Intercept (Bambi) concept has been largely ruled out by Defense officials because of its extremely high cost of implementation.

AF Graduates First Space Pilot Class

Air Force last week graduated the first class from its new aerospace research pilot's course at the Air Force Flight Test Center, Edwards AFB, Calif.

The five-man class began courses last June but future classes will attend the post graduate school for test pilots for eight months. Graduates are Majors Thomas V. McElmurray, Robert S. Buchanan and Frank Borman; Capt. James A. McDivitt, and William G. Schweikard, a civilian flight engineer. All but Capt. McDivitt will remain as instructors. He will return to duties as a test pilot engineer at Air Force Flight Test Center.

Brig. Gen. Irving L. Branch, AFFTC commander, said the school will train a pool of men to fill the expected "great need for a large number" of pilots for "suborbital, orbital and finally crew space flight" beyond the X-15 rocket research aircraft project. Pilots are not being trained for specific projects but "may be space pilots, engineers or managers, or project officers of aerospace projects," Gen. Branch said.

Project Cambridge Flash Flares Photographed Over Pacific Ocean

Flash flares carried to an altitude of 1,361 mi. by a Space-General Astrobee 1500 two-stage rocket in USAF's Project Cambridge, to triangulate the exact geodetic position of Hawaii, were successfully sighted at 521 sec., 941 sec., and 1,361 sec. after launch.

Pacific Missile Range, providing support for the project, took the opportunity to use the Cambridge lights as precise time and position references for other experiments.

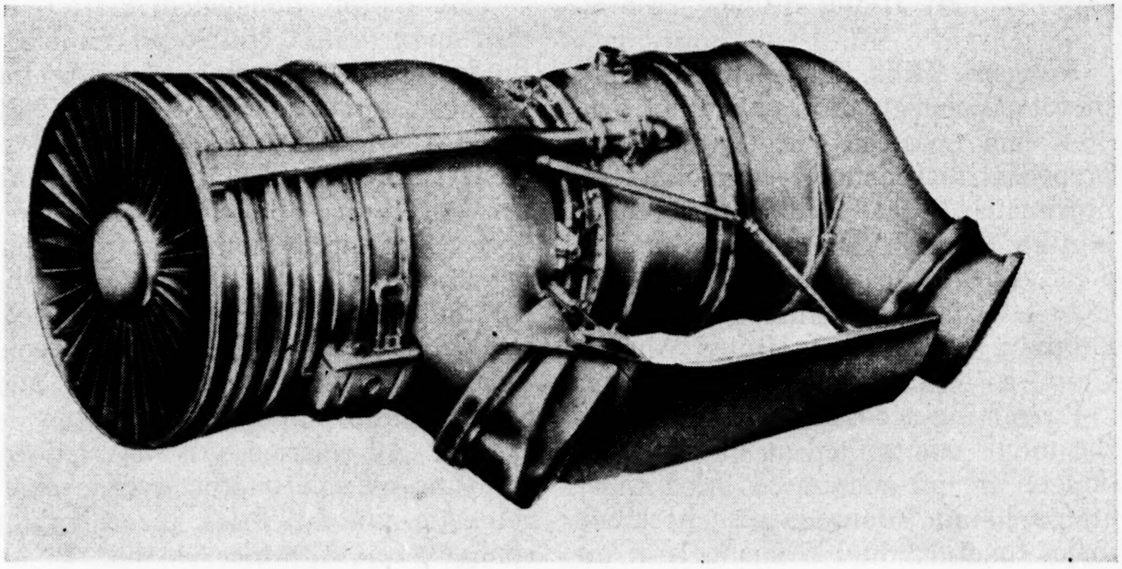
Seven-flash flares were ejected from the 90-lb. payload capsule at an altitude of 920 mi. as the final stage rocket ascended, at the 1,361 mi. apogee, and at an altitude of 900 mi. as the capsule descended. Tracking cameras took bearings on the flash charges from stations at Sitka, Alaska, Seattle, San Francisco, San Diego, and the islands of Oahu and Hawaii. The experiment was postponed twice because of overcast skies near Hawaii. An earlier attempt last August failed because of a malfunction of the booster rocket.

Project Cambridge is named after the USAF Cambridge Research Laboratory which is conducting the experiment. The six stellar geodetic cameras photographed the flashes made by the three cartridges against backgrounds of stars which will aid data reduction teams in obtaining precise lines of bearing and elevation. The 62-million candlepower flares are visible at distances up to 8,000 mi. under good conditions. Each flash has a duration of 12.2 milleseconds. Many independent observatories in the western United States attempted to photograph the flares.

The Cambridge launch vehicle was a two-stage, 32-ft.-long Astrobee 1500 which consists of a 57,000.-lb-thrust Aerojet Junior assisted at launch by a pair of side-mounted Thiokol Recruit rockets, each adding 35,000 lb. thrust for 1.5 sec. Burning time of the main booster is 28 sec. The Aerojet Alcor second stage produces 8,000 lb. thrust for 30 sec.

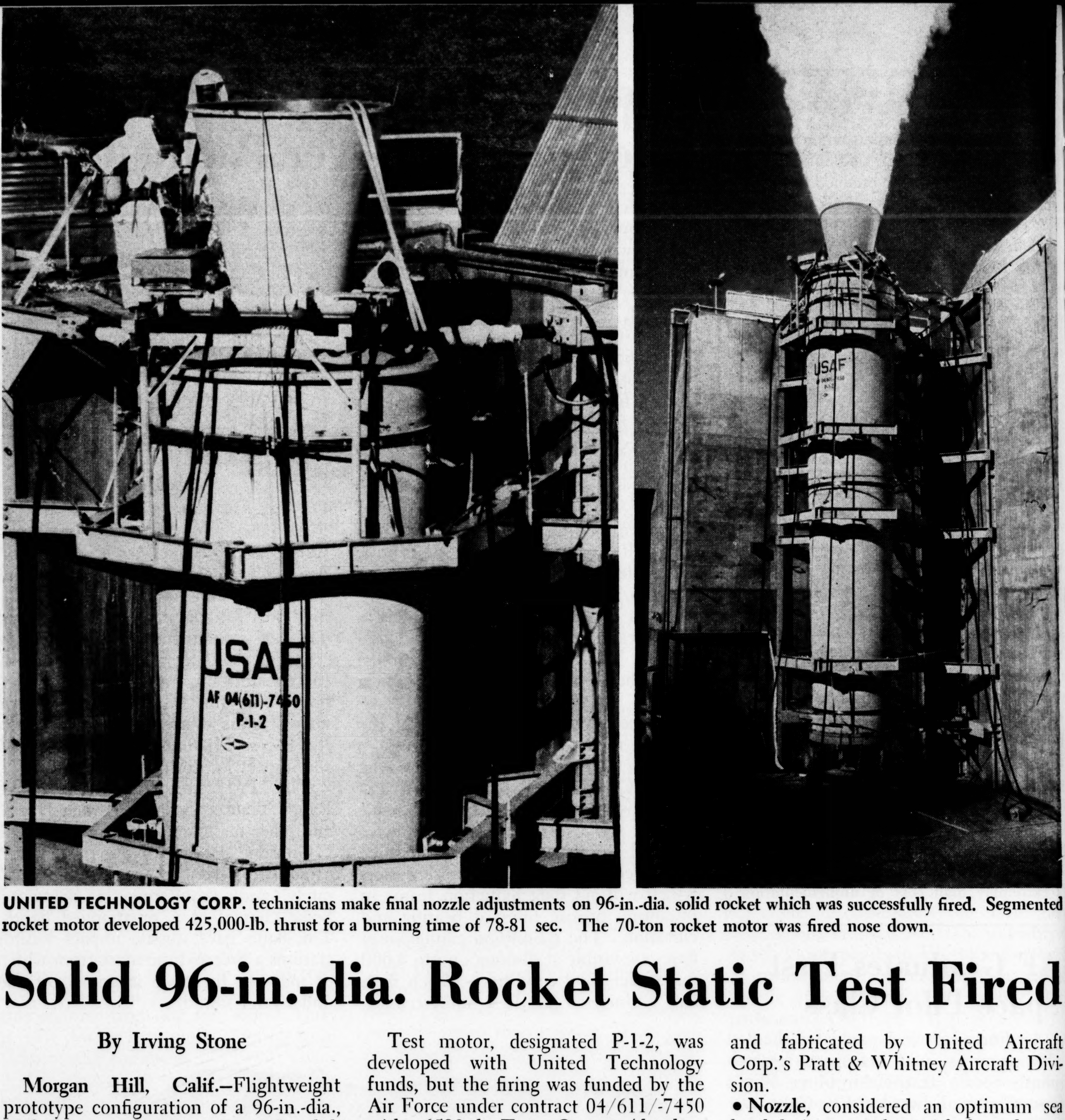
Launch was conducted by the Launch Division of Pacific Missile Range. PMR also took advantage of Project Cambridge to experiment with a combination of the rocket flare triangulation technique and underwater acoustic methods for oceanographic mapping. The side experiment also measured the speed of sound in water as a check on the theoretically predicted speed. It is hoped that this will improve the accuracy of nose cone impact location by the Pacific Missile Range acoustic missile impact locator stations.

The PMR recovery ship, USNS Range Tracker located between Hawaii and the mainland photographed the Cambridge flares with a gyro-stabilized camera to determine its position accurately and simultaneously detonated Sofar charges at a prearranged depth. The flares gave missile impact locator stations a precise time mark from which to measure the time in transit of the underwater sound.



Bristol Siddeley BS.100 Lift Engine Details

First view of the Bristol Siddeley BS.100 swiveling nozzle lift/thrust engine shows a general resemblance to configuration of the BS.53 Pegasus, its predecessor. Engine is reported to be about the same size as the BS.53. Bristol Siddeley designed the engine to produce 38,000 lb. thrust. The engine, a company-funded project, has not yet been built. Note extension between forward and aft nozzles, which could be used to conduct cooling air to the aft nozzle. Engine is designed to power the Republic-Fokker Alliance VTOL entry (AW Nov. 27, p. 28) and the Hawker Siddeley P.1150, a follow-on to the present P.1127 VTOL fighter prototype.



UNITED TECHNOLOGY CORP. technicians make final nozzle adjustments on 96-in.-dia. solid rocket which was successfully fired. Segmented rocket motor developed 425,000-lb. thrust for a burning time of 78-81 sec. The 70-ton rocket motor was fired nose down.

Solid 96-in.-dia. Rocket Static Test Fired

By Irving Stone

Morgan Hill, Calif.—Flightweight prototype configuration of a 96-in.-dia., 43-ft.-long, conically segmented solid-propellant rocket motor—developing approximately 425,000 lb. thrust for a burning time of 78-81 sec.—was fired in a nose-down position on a vertical, static-test stand by United Technology Corp., a subsidiary of United Aircraft Corp., at its development center here.

Performing according to predictions, the motor was ignited at the split-second of the pre-announced firing time, after a 30-min. countdown to check out major functions in 125 channels of information for returning data on propulsion parameters.

Test was a demonstration to Air Force officials of United Technology's development capability in relation to the upcoming Air Force competition to be held for development of a 120-in.-dia. rocket motor, expected to be used for a variety of space booster applications (AW Dec. 11, p. 26).

Test motor, designated P-1-2, was developed with United Technology funds, but the firing was funded by the Air Force under contract 04/611/-7450 with 6593rd Test Group (development), Edwards AFB, functioning under Air Force Systems Command's Space Systems Division. The P-1-2 configuration was twice the size of the P-1 configuration fired by United Technology on Aug. 5, 1961, under contract with National Aeronautics and Space Administration.

Little information was revealed by company officials on the specific characteristics of the P-1-2 rocket motor configuration, the first of this size to be developed or fired by the firm.

Aviation Week did, however, learn that:

- **Mass ratio of the motor** was slightly under 0.90, a high value. Propellant load was approximately 132,000 lb.—contained in two center sections and two end-closure caps.
- **Motor case,** rolled and welded steel, was designed by United Technology and fabricated by United Aircraft Corp.'s Pratt & Whitney Aircraft Division.
- **Nozzle,** considered an optimum sea level design, was about 6 ft. long, largest diameter was approximately 5 ft., expansion ratio was approximately 7 to 1. Built by California-General, San Diego, nozzle's exit cone had a steel outer jacket insulated with a glass-phenolic liner downstream of the throat, which was composed of a three-segment refractory carbon material, and designed so that it may be scaled easily for substantially larger nozzle sizes.
- **Taper of the conical** configuration from the maximum diameter of 96 in. was very slight, probably not more than 1.5 deg. half-angle.
- **Propellant web** exceeded 2 ft., probably the thickest grain ever cast. Indications are that the slump (flow of the propellant) was practically negligible in an eight-month period.
- **Core was a true** circular cross-section, chosen for minimum stress concentration. Trend has been toward this core

configuration, and it is likely that it will be followed in future rocket motor designs, considering the success of this United Technology firing.

- **Propellant was identified** only as a "high-performance rubber-base compound," but it is known in the industry that United Technology is working with, and probably used for this firing a rubber-base polybutadiene acrylonitrile (PBAN) fuel plus ammonium perchlorate as an oxidizer. Propellant probably contained an aluminum powder, to raise specific impulse, a common practice in the industry, and used in the solid propellant of the Minuteman ICBM. A chemical additive probably also was used to control burning rate.
- **Specific impulse** of the fuel also was not revealed, but safe conjecture is that a value of 245 sec. was obtained. Information is that the firm has been getting this value consistently in tests.
- **Chamber pressure,** also not revealed, probably would fall somewhere between 500 and 750 psi. at sea level for a motor of this type and size.
- **Igniter** was a United Technology-designed small rocket motor, adapted specially for this firing.
- **Thrust vector control** by fluid injection probably was used, since reasonable results are difficult to obtain in small-scale laboratory firings, although UTC officials would not comment on whether thrust vector control was used in this particular firing.

Thrust vector control research is considered of prime importance in the development of large solid-propellant boosters, such as the 96-in.-dia. unit fired here and those of larger size contemplated under the 120-in., 156-in. and 240-in. rocket motors envisioned in the future for Air Force and NASA use, respectively.

Thrust vector control investigation is included in the applied research contracts which have just been negotiated by Aerojet-General, Lockheed Propulsion Co. and United Technology with the 6593rd Test Group (Development), Edwards AFB (AW Dec. 11, p. 26).

Propulsion companies are investigating both Freon (an inert gas) and nitrogen tetroxide for thrust vector control. Use of nitrogen tetroxide is considered more promising because it affords an opportunity to obtain a substantial additional thrust in the vector, by reaction of the nitrogen tetroxide with free hydrogen in the exhaust stream.

Industry estimates are that perhaps 5% of the rocket motor total thrust may be obtained with thrust vector control, a sizable input for an auxiliary system, the prime function of which is to divert the vector.

Post Firing Appearance

Within a reasonable time following the firing, the motor case was cool to the touch, indicating that the interior surface of the steel shell also was cool, or the heat would have soaked through to the outside. External paint also was intact. Segment joints were cooler than the case, since there was more insulation in these areas. No movement of the joints was indicated upon ignition, and following the firing there was no evidence of joint separation.

Actual mixing time for the 96-in.-dia. rocket motor propellant took slightly less than three days. Assembly time for the motor consumed about three-and-a-half days. The large in-ground oven, which can accommodate a 20 x 50-ft.-length rocket motor case pulls a vacuum down to 5 or 6 mm. of mercury for removal of trapped air in the propellant and to produce a dense grain. This large oven will handle up to 250,000 lb. of propellant in a single charge. Two other smaller ovens, 14 x 30 ft., have propellant capacities up to 100,000 lb.

Life of propellant formulations developed by United Technology is reported to be five to seven years, retaining about 97% of original properties, without environmental control.

Scout Motor Development Problems

Washington—Series of problems in development of the advanced fourth stage Scout motor has caused the National Aeronautics and Space Administration to seek a second research and development source for the motor, designated X-258.

Hercules-Allegany Ballistics Laboratory, which has the contract for both third and fourth stages of standard and advanced Scout vehicles, said the problems are normal to advanced propulsion packages, and solutions are anticipated within the next few weeks. Neither Hercules nor NASA would detail the difficulties, but NASA said prospective bidders are being advised that the second contract may not be fulfilled if Hercules overcomes the troubles.

Hercules said the new motor already has demonstrated its principal performance parameters.

The X-258 is to have a 28-sec. burning time and a thrust of 5,000 lb. It will replace the X-248 Altair, which has a 38-sec. burning time and 3,100-lb. thrust. NASA's Langley Research Center issued a request for bids, due Dec. 15, for research and development on three configurations of an improved Scout fourth stage. The three configurations are for various payload envelope shapes.

New Power Source For Space Is Shown

New type of exotic electric power source, an electro-hydrodynamic converter which shows promise as a high-voltage, high-power source for possible space vehicle use, has been successfully demonstrated by General Electric's Missile and Space Vehicle Department.

Although the principles of electrohydrodynamics (EHD) are not new, GE says it believes it is the first to operate a unit which produces more electricity than it consumes. The present experimental model has produced 1.4 milliwatts at 170 volts while requiring only 0.1 milliwatt excitation from an outside power source, GE says.

The new EHD converter bears some resemblance to the magneto-hydrodynamic (MHD) converters under development by Avco, GE and others. Both types are expected to produce extremely high power levels, possibly in the megawatt range, with a high ratio of output power to weight.

The MHD converter uses a plasma moving through a magnetic field to generate electricity somewhat in the manner of a conventional generator, with the plasma serving as the conductor. The new EHD unit's operation more closely resembles a vacuum tube. In the GE device, a stream of compressed air is invected through a corona ring containing a probe. A voltage is applied across probe and ring sufficient to cause the air to ionize as it passes through the ring.

The resulting electrons are drawn off in the area of the corona field while the positively-charged ions are pushed down stream by neutral atoms of air to a collecting grid. The corona ring is electrically connected to the collecting ring through the outside load, so that as the electrons move from the ring to the collecting grid to recombine with the positive ions, they produce an electrical current through the load.

In the present experimental model the separation between corona (ionization) ring and collecting grid is several centimeters, according to John Smith, one of the project engineers at Philadelphia. The company is reluctant to predict what power outputs and efficiencies may be achieved, but theory indicates that an output of 20 kilowatts could be obtained with an ionization ring area of about one square meter.

The output voltage is proportional to the distance between the two electrodes, the density of the ionized particles and to the resistance of the load. Present theory indicates that voltages in the kilovolt range can be obtained, suggesting that the new EHD converter might be useful for powering ion engines in space vehicles.

U.S., USSR Agree on Space, Disarmament

By George Alexander

United Nations, N. Y.—United States and the Soviet Union reached agreement last week on two critical areas—disarmament and the peaceful uses of space—as they joined in the sponsorship of two resolutions on these subjects presented to the United Nations.

In presenting the draft resolution on disarmament to the UN's Political and Security Committee, the U. S. and USSR called for a new Disarmament Committee composed of 18 nations that would undertake, as a matter of the utmost urgency, negotiations leading toward general and complete disarmament.

The negotiations are to be based upon the principles of disarmament agreed to by the U. S. and the Soviets in a joint letter addressed to the president of the UN's General Assembly last September:

- **Disarmament is to be general** and complete, and reliable procedures are to be established for the peaceful settlement of international disputes. War is not to be an instrument of resolving international problems.
- **Only non-nuclear armaments,** forces, facilities and establishments shall be allowed for preservation of internal order and the personal security of citizens. Each state will provide an agreed-upon levy of troops for a UN peace force.
- **Armed forces** are to be disbanded, as well as military establishments and bases. Production of arms is to cease and the means of production converted to peaceful uses. All nuclear, chemical, bacteriological and other weapons of mass destruction are to be destroyed and their production halted. All weapons delivery systems are to be scrapped, military training discontinued and military expenditures are to be stopped.
- **Disarmament should proceed** in sequential stages, with each stage carried out within specified time limits.
- **International control** should be exercised over the process of disarming by the strict and effective authority of an international disarmament organization.

Ambassador Adlai Stevenson, U. S. representative to the UN, said that the negotiations called for by the joint resolution were of extreme importance and that "to the extent to which they are successful, mankind will be relieved of the danger of war which now overshadows all peoples and all countries. . . . The delegation of the United States and the USSR have worked together intensively to produce the resolution which is now before you."

The 18 nations proposed for the new Disarmament Committee include the 10 countries of the former disarmament group—five Western and five Communist—and eight neutrals:

- **Western nations** are the U. S., United Kingdom, Canada, France and Italy.
- **Communist states** are the USSR, Bulgaria, Czechoslovakia, Poland and Rumania.
- **Neutral countries** are Brazil, Mexico, Ethiopia, Nigeria, Burma, India, United Arab Republic and Sweden.

This new committee was asked by the joint U. S.-USSR resolution to report on any disarmament agreement as soon as it has been reached but in any event to submit a progress report no later than June 1, 1962.

After the resolution had been approved by unanimous vote of the Political Committee, Soviet Representative Valerian A. Zorin arose to interject a warning to the Western powers that if they failed to agree to the Soviets' latest nuclear test ban proposals, "the Soviet government would be compelled to take the decision to conduct nuclear weapon tests in the Soviet Union so as to keep the defense capacity of the country at an always adequate level."

The Soviet representative's remarks brought sharp and prompt rejoinders from the U. S. and British delegations; the committee chairman, Dr. Mario Amadeo, of Argentina, rebuked Zorin for introducing a statement not in line with the committee's present subject.

The U. S. and the Soviet Union also found themselves in agreement earlier in the week as they joined the other 22 nations of the UN's Committee on the Peaceful Uses of Outer Space in presenting a draft resolution that would provide a basis for international cooperation in the exploration of space.

The U. S. and USSR, which have disagreed for almost two years over procedures to be followed by the space committee in its work (AW Dec. 4, p. 29), declared that they had reached agreement through a week-long series of consultations on the draft resolution. The resolution was a slightly modified version of a draft presented the previous week to the UN Political and Security Committee by the U. S., Australia, Canada and Italy.

Neither the U. S. nor the Soviet missions would divulge the details of their agreement, but some UN observers believed that each had yielded ground on their previous positions—the U. S. had maintained that committee decisions be reached by majority vote of the members, as other UN committees operate, and the USSR had insisted that decisions be reached through unanimity of the committee members. The U. S. had contended that the Soviet demand for unanimity was tantamount to veto power.

Soviets now are understood to be less insistent on unanimity for several possible reasons:

- **Most matters** arising before the committee are expected to be of such a noncontroversial nature that all nations, Western or Communist, would support them unanimously. The USSR was said to have found little backing from other nations on the space committee for its stand on unanimity.
- **To draw attention away** from their recent series of nuclear tests and give added emphasis to their claim of being the leading proponent of peace.
- **To create a favorable atmosphere** within the UN for their forthcoming proposals on nuclear test ban and disarmament questions. The feeling among some UN observers is that the Soviets are willing to lose a battle in the space committee to win the war on these latter two matters.

The 24-nation draft resolution, which was approved unanimously by the Political Committee—to which the space committee reports—incorporated the following points:

- **International law,** including the UN Charter, applies to outer space and celestial bodies. Space is free for explo-

Hammarskjold Probe

United Nations, N. Y.—Five-man commission has been named by the president of the United Nations General Assembly to investigate the circumstances surrounding former UN Secretary-General Dag Hammarskjold's death Sept. 18.

Hammarskjold, along with 12 other UN employes, died when his DC-6B crashed in Northern Rhodesia.

Commission members include Justice Samuel B. Jones, Sierra Leone; Dr. Raul A. Quijano, Argentina; Justice Alfred E. Sandstrom, Sweden; Rishikesh Shaha, Nepal and Nikola Srzentic, Yugoslavia. They will select a chairman next week.

Comsat Launch Plans

Washington—National Aeronautics and Space Administration last week released the schedule for 10 experimental communications satellite launchings. The timetable is:

Second quarter, 1962—American Telephone & Telegraph Co. Telstar, followed by a NASA-Radio Corp. of America Relay satellite.

Third quarter, 1962—Relay.

Fourth quarter, 1962—Relay, followed by Telstar, NASA-Hughes Aircraft Co. Syncom, and another Telstar launch.

First quarter, 1963—Relay, Syncom.

Second quarter, 1963—Syncom.

ration and use by all nations in accordance with international law and celestial bodies are not subject to national appropriation by claim of sovereignty.

- **Data on space vehicles** placed in orbit or launched on deep probes will be furnished promptly to the Committee on the Peaceful Uses of Outer Space for registration. The UN Secretary-General is requested to maintain "a public registry" of the information provided. In the original four-power (U. S., Australia, Canada and Italy) draft, the data would have been forwarded to the Secretary-General.
- **Early and comprehensive study** of measures to advance the state of atmospheric science and technology so as to provide greater knowledge of forces affecting climates and the possibility of large-scale weather modification. Working through the UN's World Meteorological Organization, the space committee hopes to develop existent weather forecasting capabilities and help nations make more effective use of these capabilities through regional meteorological centers.
- **Satellite communications,** on a global and non-discriminatory basis, is to be pursued through the agency of the International Telecommunications Union (ITU), with the ITU at its 1963 meeting requested to make allocations of radio frequency bands for space communications activities. The space committee also will ask the Expanded Program of Technical Assistance and the UN Special Fund, in cooperation with the ITU, to assist nations in a survey of their communications requirements and the development of domestic facilities necessary for active participation in such a space communications system.

On the last two points, the 24-nation draft differed from the four-power resolution in the substitution of the World Meteorological Organization and the International Telecommunications Union for the Secretary-General. Ambassador Charles W. Yost, U. S. Deputy permanent representative, said that these changes were made "at the suggestion of a number of delegations which considered that studies of the technical nature envisaged should most appropriately be under the direction of the specialized agencies involved."

New Members

The 24-nation resolution also called for the addition of Chad, Ghana, Mongolia and Sierra Leone to the space committee. Ghana declined the invitation and Morocco was substituted in its place. The original four-nation draft had called only for the addition of Chad and Nigeria.

The revised draft called upon the space committee to meet not later than Mar. 31, 1962, to carry out its original mandate, to consider the activities proposed in this resolution and to study and report to the General Assembly on the legal problems which might arise from the exploration and use of outer space.

Both resolutions were expected to be forwarded to the UN's General Assembly either late last week or early this week, where approval of both was predicted by UN observers. The Political Committee is a committee of the whole, and the nations who vote in this group are the same nations that will vote on the drafts in the UN's General Assembly.

Nuclear Tests Were Profitable to Soviets

Washington—Soviet Russia's recent series of about 50 nuclear explosions in the atmosphere involved considerably cleaner devices than expected and represented "substantial progress," particularly in improving yield-to-weight ratios of weapons in the megaton range, the U. S. Atomic Energy Commission said.

Meanwhile, Soviet Premier Nikita Khrushchev said in Moscow that Russia has "bombs stronger than 100 megatons," and added: "We placed Gagarin and Titov in space and we can replace them with other loads that can be directed to any place on earth."

AEC said the fission yield in comparison to total yield of some of the large weapons in the series "is lower than achieved in their previous tests. Of special interest is the small fission yield of the 55-60 megaton test conducted on Oct. 30."

Total fission yield for the series is estimated at about 25 megatons out of a total yield of about 120 megatons, AEC said. This probably means that fission triggers for bombs and warheads that gain most of their yield from the fusion reaction have been decreased. In previous U. S. and Soviet tests, approximately 50% of the total force came from the fission reaction. This also means the Soviet series will produce far less fallout next spring than had been predicted before.

Significance of the Soviet developments to the security of the U. S. is still being evaluated, AEC said. But it said there is "no reason to believe that the balance of nuclear power has been changed to favor the Soviet Union. This balance depends not only on nuclear technology but also on numbers of weapons available and effective systems of delivery," AEC said.

The U. S. last week exploded a low-yield (less than one megaton) device underground. It was the sixth explosion announced since the U. S. resumed tests two weeks after the Russian series began on Sept. 1.

Contract Is Awarded For Michoud Service

Washington—Mason-Rust Co., a combination of two firms, has been awarded the housekeeping contract for the Michoud Operations facility near New Orleans, La., where three large vehicle stages will be produced for the National Aeronautics and Space Administration. Estimated annual cost for the supporting services contract is $1.25 million.

Parent organizations of the combine are Rust Engineering Co. of Pittsburgh, Pa., and Mason and Hanger-Silas Mason Co. of Lexington, Ky. Mason-Rust will provide transportation, security, fire protection, photo, medical, food, communications, custodial, plant maintenance and repair, engineering, messenger, mail, refuse disposal, printing and utility services for the three separate production contractors which will occupy the plant.

NASA was expected to announce the winner of the Saturn S-1B contract late last week, and the Rift nuclear stage contractor will be chosen early next year. These two contractors will occupy Michoud with Chrysler Corp., which won the Saturn S-1 contract.

NATO Hawk Output To Begin Next July

Paris—Production of Army-Raytheon Hawk air defense missile by West European NATO-sponsored combine now is slated to get under way in July of next year.

New production schedule represents slippage of some nine months. Program presently involves expenditures of over $500 million, most of which is being put up by European NATO countries involved: Belgium, France, Germany, Italy and Holland.

NATO Hawk program currently involves 26 Hawk battalions. Based on probable cost of $20 million per battalion, over-all program will amount to $520 million. All but two of the battalions will be built by European combine, Societe Europenne de Teleguidage (STEL). Two battalions will be assembled this spring in Europe out of U. S. supplied kits.

Breakdown of national involvement is as follows: West Germany, nine battalions; Italy, four; France, Belgium and Holland; three each.

Balance of four battalions—representing some $80 million in hardware—will be distributed by U. S. under military assistance program. U. S. financial involvement in the 22 battalions for the five NATO countries is only $35 million out of total cost of $440 million for the 22.

No. 3 X-15 Is Ready For First Test Flight

Los Angeles—First flight of the No. 3 North American X-15 with a newly designed Minneapolis-Honeywell adaptive control system will be made as soon as rain-softened Rogers Dry Lake at Edwards AFB, Calif., hardens enough to bear the aircraft's skid-type landing gear.

The lake surface has been softened by recent rains, halting the X-15 flight program. If it does not dry soon, a captive flight aboard the Boeing B-52 carrier aircraft may be made to check X-15 systems.

The No. 3 aircraft was partially destroyed by an explosion in the propellant system June 8, 1960. It was rebuilt by North American and returned to the joint NASA-USAF-Navy project last September. It was never flown before the explosion.

The first mission will be flown by NASA Test Pilot Neil Armstrong. Performance peaks will be limited to 2,400 mph. and 75,000 ft. altitude. Because the mission is intended primarily as the first X-15 flight test with the adaptive control system (AW Nov. 20, p. 95), engine power will be limited to 50% of its 57,000-lb. rated thrust during the 104-sec. powered flight segment. The entire flight will last nine minutes.

Except for a 250,000-ft. design altitude flight, most future high altitude X-15 flights will be made by the No. 3 aircraft. It will also be used to test new systems.

RAF Orders AS-30 Missiles From Nord

Paris—Nord Aviation marked its first export order for its AS-30 air-to-ground missile with a $14 million order placed by Royal Air Force.

The Nord missile is a competitor of the Martin Bullpup. The AS-30 travels at supersonic speeds and can be fired from aircraft traveling supersonically at the time of launch. Body length is 11.5 ft. and range is about seven miles.

The AS-30 currently is being mass-produced by Nord for French air force use as well as for other possible export markets. Nord hopes to capture much of the European market for air-to-surface missiles from Martin.

Nudets Contractor

General Electric has been selected by Air Force Electronic Systems Division to develop new nuclear detection system (477L), known as Nudets, which is intended to pinpoint site of any nuclear detonation within the continental U. S. Dresser Industries will be a major subcontractor on the program.

PERT Contract

Air Force Electronic Systems Division is seeking companies experienced in Program Evaluation Review Technique (PERT) for a short-term contract to assist it in applying PERT to some of its command and control system development programs.

Defense Gets Protest On N. Y. Contract Loss

Washington—New York's congressional delegation last week protested what it called the "staggering decline" in the state's share of military procurements, from 12.5% in the third quarter of 1960 to 8.1% for the same period this year.

This was a cut of $243 million, or 40%. Air Force contracts dropped 63%.

In a letter to Defense Secretary Robert S. McNamara, the delegation's steering committee, headed by Rep. Emanuel Celler (D.-N. Y.), declared that the situation "is truly shocking when read in relation to the statistics reflecting the increasingly dominant role played by the state of California in these procurements." California's allocation rose from 22.5% of the total in the third quarter of 1960 to 23.7% for the third quarter this year.

Air Force contracts of $625 million to California during the July-September period this year compared with $96.5 million for New York.

Although a substantial amount of prime procurements are subcontracted, the Celler committee commented, "it is not unreasonable to assume firms proximate to the area of vast spending do gain and will continue to gain by a mere fact of proximity."

New York's steady decline in defense business following the Korean War was halted in mid-1959 after a vigorous campaign by its congressional delegation. While New York's share of defense contracts declined from 18% in 1951 to 11% in 1959, California's portion increased from 13% to 21%.

News Digest

Fred Korth, a Ft. Worth, Tex., attorney and businessman, has been appointed secretary of the Navy by President Kennedy, to succeed John B. Connally, Jr., also of Ft. Worth, who will run for governor of Texas. Korth, 52, formerly was assistant Army secretary and served as an Air Force lieutenant colonel in World War 2.

General Dynamics Atlas 5-F flew successfully over the Atlantic Missile Range last week, ejecting a pod containing 28 simulated nuclear fuel cores to test the effect of wall-thickness on the rate at which the cores burn on re-entry. Two earlier experiments have tested the effect of configuration on re-entry heating. Cores were designed by Martin Marietta Corp. for Atomic Energy Commission. Air Force Special Weapons Center was test coordinator.

Elliot Mitchell has resigned as assistant director of Manned Space Flight Programs for Propulsion, National Aeronautics and Space Administration, to be an independent consultant. He had been a Navy and NASA propulsion manager 19 years.

First Minuteman facility at Vandenberg AFB, Calif., has been turned over to the Air Force by the Army Corps of Engineers. Initial turnover included two launching silos and a launch center.

USAF-Lockheed Discoverer 36 was successfully orbited with a University of Illinois upper atmosphere radio propagation experiment aboard as well as the Oscar 1 amateur radio satellite. The propagation experiment payload consists of a 100 milliwatt transmitter sending on 20.005 mc. and 40 mc.

Control system and ground guidance of Army's Western Electric-Douglas Nike Zeus anti-ICBM were successfully tested at White Sands Missile Range in a launch with an inert jet-head motor in the final stage. The missile was launched from an above-ground rail-type launcher used in development tests and correctly executed maneuver commands. Also evaluated in the test were the missile aerodynamics, structures and the first two stages of propulsion.

Civil Aeronautics Board last week granted Eastern Air Lines authority to operate the Toronto-Florida route and authorized Mohawk Airlines to operate single-plane service between Toronto and upstate New York cities. American Airlines was given permission to suspend service between Toronto and Buffalo.

Last USAF-Martin Titan 1 research and development missile was launched over the Atlantic Missile Range last week. Forty Titans have been fired from Cape Canaveral as Titan 1 test shots since Feb. 6, 1959. Five more have been launched there as Titan Ms—testbeds for components of the Titan 2. One has been fired from Vandenberg AFB, Calif., as a Titan 1 and one as a Titan M to check out Titan 2 silo.

Brown & Root, Inc., of Houston, Tex., has been awarded a $1.5-million contract for architectural and engineering design of NASA Manned Spacecraft Center near Houston.

CAB Plans to Expedite Merger Hearing

National-Continental proposal will test whether—or to what extent—Board will foster realignments.

By Glenn Garrison

New York—National Airlines-Continental Airlines merger proposal is expected to receive an expedited hearing before the Civil Aeronautics Board and possibly to be processed by the Board within nine months or a year.

The proposal, filed last week in the form of an initial agreement between the two carriers, calls for the merger of National into Continental, with the surviving corporation to be Continental. However, the name of the merged company will be "National-Continental Airlines, Inc.," under the proposal.

Strongly significant to the airline industry in the case will be two major points: attitude toward mergers of the CAB as a whole, and whether the National-Continental proposal fits CAB criteria for merger. Board Chairman Alan S. Boyd has publicly encouraged further mergers by domestic trunklines as probably the best solution to the problem of overcompetition, though he made it clear he spoke for himself and not the entire Board. Boyd said mergers should be in the public interest, should leave a reasonable degree of competition, should result in better integrated route structures and sounder financial condition for the surviving carriers (AW Nov. 6, p. 37).

The National-Continental proposal is expected to be opposed by at least some major carriers, and whether it meets the above conditions is likely to be a point at issue in the case.

Boyd told Aviation Week the procedures probably will be expedited in the case, and he estimated the time involved as possibly about nine months to a year. The two carriers, in their merger application filed last week, said the application was being filed prior to approval by their respective boards of directors of a definitive agreement in order that preparations could be made for an expedited hearing. An expedited proceeding will be requested, they said, as soon as a definitive agreement has been filed.

Every effort will be made, the carriers said, to consummate a definitive agreement within 60 days.

Under the proposal, G. T. Baker, chairman of the board of National Airlines, becomes board chairman of the new airline. Robert F. Six, president of Continental, becomes president of the combined carrier. R. E. Wieland, president of National, becomes first vice president of the new carrier and assistant to the chairman of the board.

Holders of National common stock, under the agreement, will receive 1¾ shares of Continental stock for each share of National.

Both carriers last week were withholding further details of the probable final arrangement, but financial and airline circles were speculating about some questions concerning the plan:

- **Importance of Chicago-to-the-East** route for the combined airline. Continental has filed for route extension beyond Chicago. Without this extension, the new carrier would have a peculiar gap in its route structure: It would fly from Chicago to the West Coast, from the West Coast to the Southeast over the southern transcontinental route, and along the East Coast from Florida to Boston, but would have no connection between the Northeast and the Midwest. With such a route extension, it would have two transcontinental routes. It was felt that National-Continental Airlines would be sure to push for the route extension and would surely be strongly opposed.

Northeast Aid Cleared

Washington—U. S. District Court of Appeals here, in a 2-1 decision, last week refused to block Hughes Tool Co. from granting emergency financial aid to Northeast Airlines to save the carrier from possible receivership.

The decision may also clear the way for stock control of Northeast by Hughes Tool and an ultimate merger of the airline into TWA. The case was brought into court by Eastern and National airlines on grounds that the Civil Aeronautics Board acted illegally in authorizing the airline to accept interim financial help, while the Board had not determined whether Hughes already owns Northeast.

In granting Hughes authority to lend Northeast the money it needs to operate during the Florida tourist season, the Board noted that it assumed giving assistance to Northeast could result in control by Hughes Tool. During hearings preceding the CAB decision, a Hughes Tool representative said that Hughes Tool would not be interested in extending aid to Northeast unless it could gain control of the airline. Late last week, Northeast and Hughes Tool were discussing a financial aid plan.

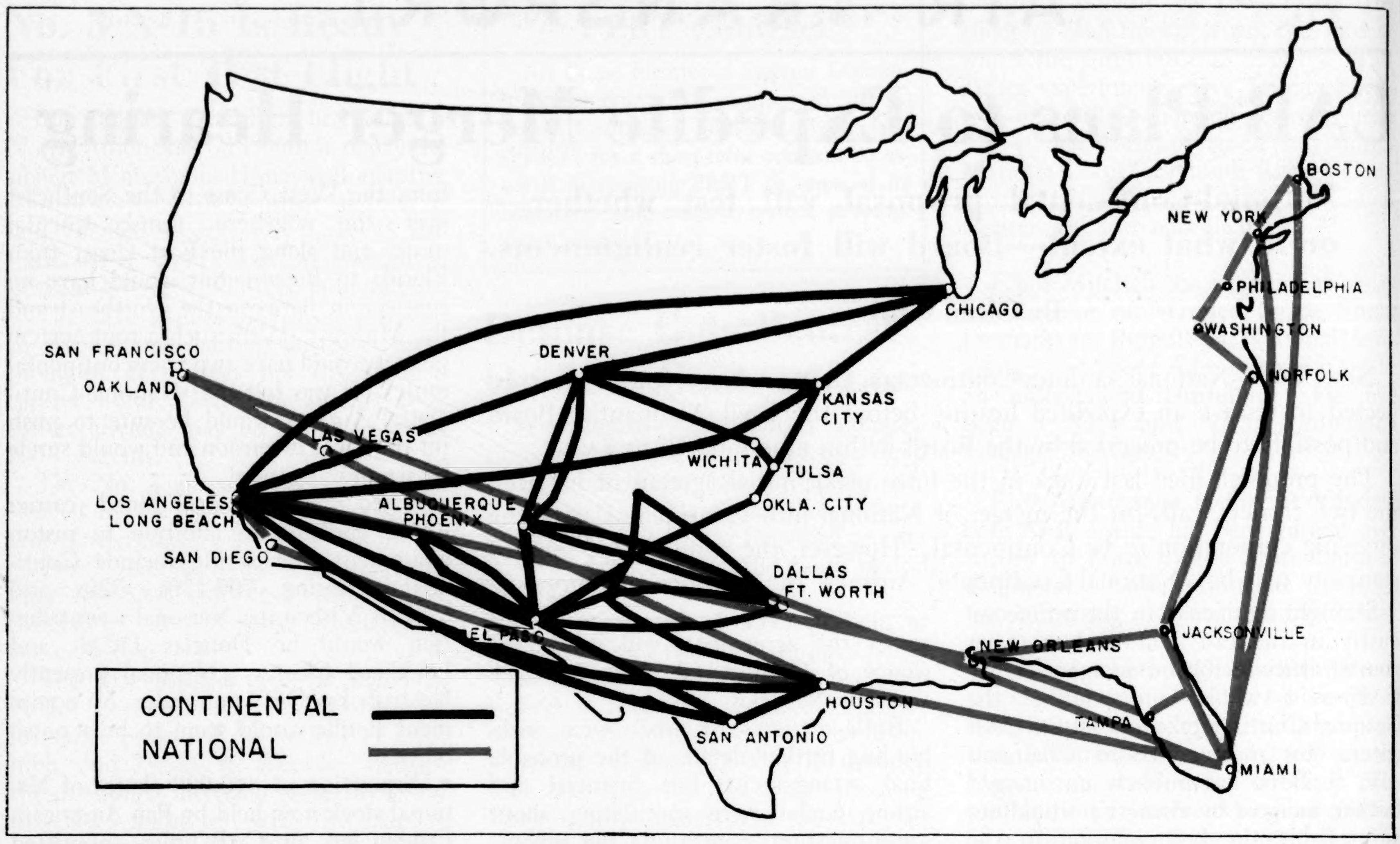
- **Mixed fleet** the combined carrier would operate. In addition to piston equipment, this would include Continental Boeing 707-120s, 720s and Vickers Viscounts; National's contribution would be Douglas DC-8s and Lockheed Electras. National presently has turbofan DC-8s on order. An equipment shuffle would seem to be a possibility.
- **Disposition of 400,000 shares** of National stock now held by Pan American. PanAm has, by CAB order, submitted a plan which calls for disposition of this stock not later than July, 1964. Bureau Counsel of CAB has recommended against this plan however, and it seems likely that CAB will order PanAm to divest at a date considerably earlier than 1964.
- **Debt position** of the merged carrier. Both have high debt ratios, and merger would simply combine the obligations. The new carrier will be bigger, but not immediately stronger financially.

Initial stock market reaction to the proposal was a National gain of one point and a Continental loss of a fraction. This, in part, was a market attempt to bring prices of the stock in line with the merger terms.

National's creditors, according to financial sources, appeared more enthusiastic about the plan than Continental's, and the market reaction tended to support this pattern.

The multiple equipment problem of a combined National and Continental could possibly be solved by re-equipping with a medium- or short-range jet to replace the turboprops, and industry sales teams are alert to this possibility. Trade-in arrangements might be vital to such a transaction. National has openly expressed interest in the Sud Caravelle and Six of Continental was one of the first airline presidents to show interest in the General Electric-engined Caravelle. Six has expressed interest also in the BAC 111, but British Aircraft Corp. doesn't regard Continental as a leading prospect for orders. Another contender could be Boeing 727 or 720B.

General Electric at one point was



ROUTE SYSTEMS of National and Continental would, if merged, result in an airline with 13,397 unduplicated route miles.

willing to take Electras in trade to sell Caravelles but may not now be so willing. Douglas and General Electric plan to send in a sales team to the airlines late this month, and BAC is expected to make new proposals in light of the possible new route system.

As far as relieving the problem of overcompetition is concerned, some observers note that a National-Continental merger would have limited effect. The two carriers compete only over the Houston-West Coast segments, both carriers having recently been awarded those routes under the southern transcontinental route decision.

National's southern transcontinental route has enabled the airline to turn the corner from a recent heavy loss position. Inaugurated last June, it connects the West Coast and eastern aerospace industries and projects (AW Oct. 23, p. 38). This route would certainly be a prime asset to the combined airline.

As to how the merger would improve the revenues of the individual carriers, one factor is the basic seasonal difference between their systems. National's peak is in winter and Continental's in summer. For example, Continental flew 90,303,000 revenue passenger miles in July, 1960, and 70,727,000 in January, 1961. National's respective totals were 80,548,000 and 97,135,000. However, these figures do not take in account the southern transcontinental route, which has changed the seasonal characteristics somewhat. But presumably the seasonally balanced route system of a merged carrier would permit more economical equipment use.

As to who would exercise day to day control of a merged airline, some observers feel the recent retirement of Baker as president of National is a clue. Baker resigned in favor of Wieland, who is his nephew.

Present combined fleet of the two carriers totals 76 aircraft, including four DC-8s, five 707-120s and 720s, 14 Electras, 13 Viscounts, 13 DC-7s and 7Bs, nine DC-6s and 6Bs, six Convair 440s, four Lockheed 1049H Constellations, and eight DC-3s.

Net worth of the two airlines is $50,038,200, divided $25,046,206 National and $24,992,000 Continental. National assets of $97,405,000 and Continental's $79,908,000 total $177,313,000.

Merger would provide a total unduplicated route mileage of 13,397, of which 6,582 represents National's system and 6,815 represents Continental's.

National's debt at June 30, 1961, totaled $52,211,852, of which $10,653,846 was in bank debt due in its current fiscal year. Of the remaining, long-term debt, $30,769,231 was in notes payable to banks, $10,288,000 was in convertible subordinated debentures, and $500,775 was in other obligations. Continental's debt as of Dec. 31, 1960 totaled $52,643,555, of which $6,483,449 was due this calendar year and presumably has been paid. Total long-term debt for the two carriers, therefore, stands at $87,718,112.

National's operating revenues for the fiscal year ending June 30, 1961 totaled $63,951,078. Continental's 1960 operating revenues totaled $61,047,583.

Sayen to Quit ALPA by June

Washington—Clarence N. Sayen, president of the Air Line Pilots Assn., bluntly declared last week that he will resign not later than June, 1962, and refuse any union effort to prolong his stay in office.

This decision will not be reversed Sayen told Aviation Week here, even if a draft is organized by a majority of the union's 14,700 pilots. The question of who will succeed Sayen is to be settled at a May 29 board of directors meeting called after the incumbent asked to be relieved of ALPA's presidency (AW Nov. 6, p. 38).

Sayen said that because he "did not want to choose his own successor" and because he wanted to ensure an orderly transition for the next ALPA administration, he elected not to resign in orthodox fashion. Had Sayen stepped down prior to the calling of the board of directors meeting, Capt. John Carroll, the union's first vice president, would have assumed the presidency automatically under ALPA's constitution. Offices of first vice president, secretary and treasurer of ALPA, as well as its presidency, will be filled by elections scheduled for the May meeting.

Industry Group Predicts 1961 Loss Of $30 Million for 11 Trunklines

Washington—Air Transport Assn. last week warned that the domestic trunkline industry may end 1961 with a net loss, after taxes and interest, of $30 million for the year.

The estimate was based on the fact that of the 11 trunk carriers, four airlines—Eastern, Trans World, Northeast and National—will record losses that would outstrip net earnings expected to be shown by the other trunks—American, Braniff, Continental, Delta, Northwest, United and Western. The industry loss would be the highest in commercial aviation history.

Earnings Slip

Previous high loss was $20.2 million reported in 1947. Since 1948, when the loss was $4.9 million, the industry has shown a consistent profit, although last year net earnings reached a bare $1.2 million.

Trunkline revenues in 1961 will reach $2 billion, according to the estimate. This represents an increase of 4% over 1960. Operating expenses this year climbed 6.1% to slightly over $2 billion.

Revenue passenger miles for the year are estimated at 29.5 billion, a 1.1% rise over the previous year. Coach traffic accounted for 57% of the total in 1961, compared with 49% in 1960 and 13% in 1959.

Available seat miles rose by only 7.7% to 52.9 billion, despite the addition of 150 turbine-powered aircraft to the industry. Normal capacity increase in the past has ranged from 12% to 22% annually.

Traffic Growth Decline

The decline in revenues was attributed by ATA President Stuart G. Tipton to the sharp decline in passenger traffic growth and a substantial diversion of passengers from first class to low-fare coach service.

The number of passengers carried by the trunklines dropped 2.2%, while the total of local service passengers carried climbed 14.3%. The number of helicopter passengers declined 9.2%, while passengers handled by U. S. flag international airlines rose 3.9%. Passengers handled by Alaskan carriers remained about the same while the volume moved by intra-Hawaiian airlines dropped a sharp 11%.

In the total scheduled airline industry, the number of passengers carried fell .17%, but revenue passenger miles increased 2.5%. Freight ton miles were up 13%, U. S. mail ton miles rose 22% and express ton miles rose .51%.

The entire industry's safety rate for the 11 months ended Nov. 30 was .32 fatalities per 100 million passenger miles, compared with .62 for the first 11 months of 1960 and .86 for the entire year of 1960.

Jet Orders

As of June 30, 1960, U. S. carriers were operating 504 turbine-powered transports, compared with 429 at the end of 1960. During the last half of 1961, 67 turbojet or turbofan aircraft were scheduled for delivery. Orders have been announced for 60 more jets in 1962 and 40 in 1963.

The ATA report said that jet revenue passenger miles accounted for more than 50% of the total domestic trunk and international passenger miles for the year ended June 30, compared with 26% in the same period of the previous year.

Employment in the entire industry reached a total of 171,000 persons this year and annual industry payroll now exceeds $1 billion, the ATA said.

Caravelle Deadline

New York—Trans World Airlines has been given additional time to make a firm decision on whether it can go ahead with its order for 20 Sud Caravelle jets. The order, announced last September, was conditional on TWA's being able to work out financing for the $100-million purchase. Decision deadline was Dec. 17 (AW Dec. 11, p. 42), but Sud has now extended this into 1962. Order involves the Caravelle 10A model.

SAS Warning

Washington—Opposition of U. S. flag carriers to foreign airline competition on North Atlantic routes could block any attempt by this country to participate in the European Common Market a Scandinavian Airlines System executive said last week.

Warren E. Kraemer, first vice president of SAS, criticized what he called the "pressure" tactics of U. S. international airlines objecting to bilateral air agreements and U. S. interpretations of the Bermuda Agreement principles.

He said that further efforts to limit foreign competition might also result in Europe being turned overnight into a cabotage area. This would legally prevent any U. S. carrier from carrying passengers within Europe. Kraemer said: "This is not to be ignored and is in the offing."

Kraemer termed present North Atlantic fares "ridiculous," and called for a greater effort among all international carriers to reduce them. Fares have not been reduced because of the International Air Transport Assn. cartel, he said. The industry's present problem of excess seat capacity over the North Atlantic is of a temporary nature and could readily be solved by lowering fares to attract a higher volume of total traffic for all carriers on the route, he said.

American Submits New Fare Formula

Washington—American Airlines proposes to increase its revenues by reducing first class and increasing coach fares on long-range routes under a formula recently submitted to the Civil Aeronautics Board.

Meanwhile, the Board has voted to suspend until Mar. 14 a series of transcontinental jet excursion fares planned by Trans World Airlines, Continental Air Lines, United Air Lines, American Airlines and Northwest Airlines. Board members also are completing a final study of a variety of fare proposals (AW Dec. 4, p. 38) and is expected to issue a fare policy statement this week.

American, describing the continuing shift of airline passengers from first class to coach services as "a principal problem for all of the industry," said it favors a realignment of its fares in this manner:

- **Reduce first-class fares** about 5% and increase coach rates by a like amount to narrow the present $40 difference on transcontinental operations. For trips exceeding 1,200 mi., this difference should not exceed $25, the carrier contends, since experience has shown high customer resistance to the present price differential charged for seating on the same aircraft.
- **For trips of less** than 1,200 mi., American also favors narrowing the price spread, but did not suggest a specific amount. While there is some consumer resistance to the present difference in this area, it is not as great as that on transcontinental routes. The airline noted that per-seat-mile costs are higher for short hauls and profit margins are lower, and said that it doubted that first-class fares could be reduced.
- **All fares should be published** in even dollar amounts to simplify tariff filings and lower the costs of ticket accounting procedures.
- **"Unproductive cut-rate plans"** should be abandoned as illogical and inconsistent with suggested fare increase proposals. The airline said it favored dropping both the transcontinental excursion fare plan and the youth discount fare plan.

El Al Tests Group Fares as Traffic Builder

By Cecil Brownlow

Tel Aviv—El Al Israel Airlines is taking a lead in the drive for lower fares as the only long-range answer to the problem faced by an expanding industry with an increasing number of seats to fill.

In the interim El Al is using a group fare system, permitted it under a special International Air Transport Assn. resolution, as a short-term approach. Success with these group charter flights in filling seats that otherwise would have remained empty leads El Al to believe in the drawing power and profit potential of moderate rates.

In the opinion of Gen. Efraim Ben-Arzi, El Al managing director and a war veteran of Israel's war of independence, lower fares are "the only way to fill up airplanes and fight the fly-by-nights. Even the governments should be concerned with the marginal, on-off season business. It's bad for the airlines and for the aviation industry as a whole." He adds:

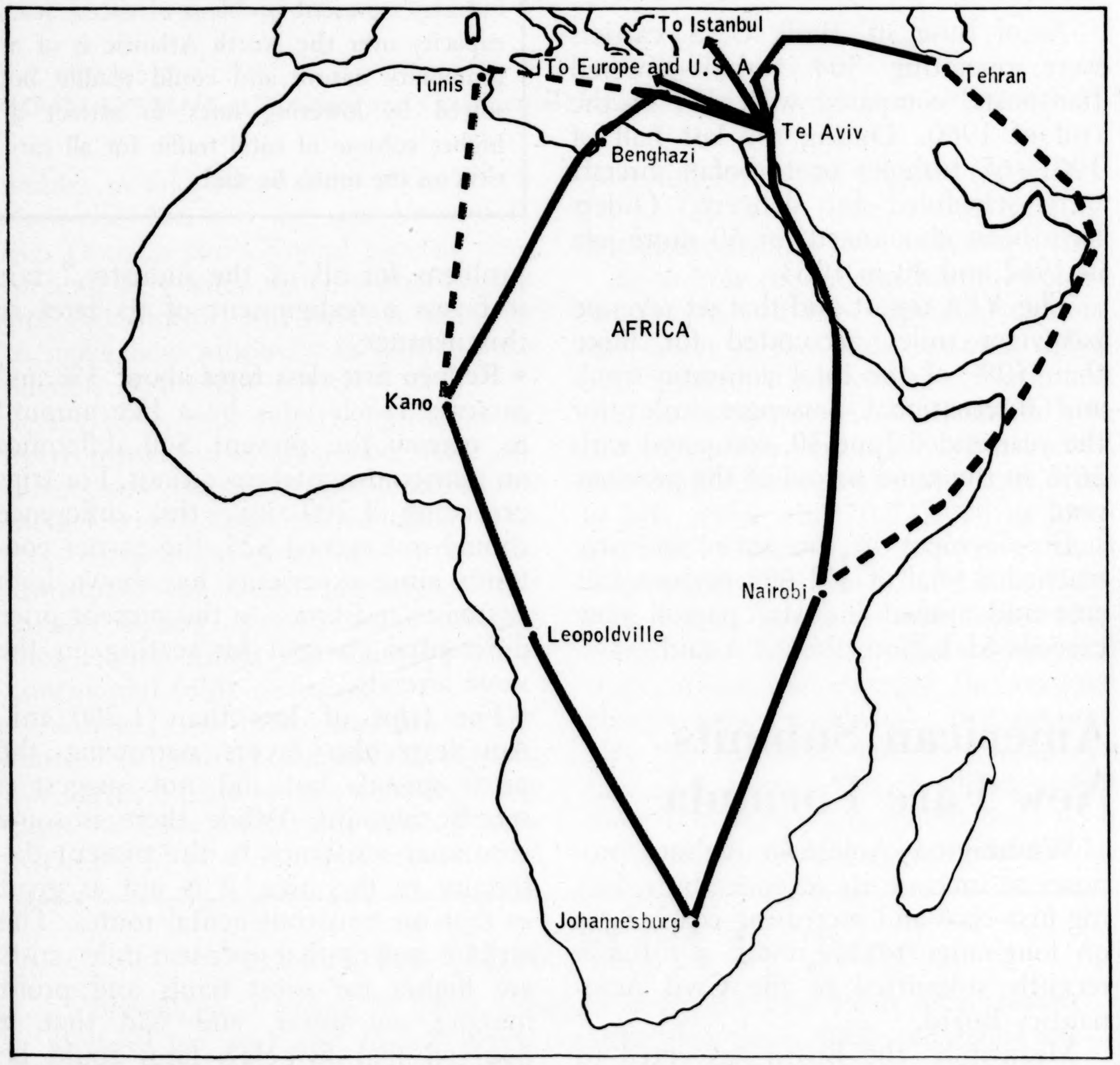
"If the IATA members would stop trying to be smart all on their own . . . stop trying to get a bigger slice of pie for themselves and work to build a bigger pie, everyone would be better off.

"We can't go on the way things are [with major boosts in seat availability without commensurate traffic increases]. We're just thrashing water."

No Subsidy

Although the majority of the airline stock is government owned, Ben-Arzi emphasizes that there is no subsidy involved, and another official of the airline says "if we can't make money, we'll sink."

Optimistic about its own future, the airline is rapidly converting to an all-turbine operation, a project that may necessitate new equipment orders. The carrier is planning extended services to New York and Europe in 1962, and is searching for new market areas to tap, possibly including South America.



POLITICAL DIFFICULTIES in the Middle East between Israel and the Arab nations have dictated El Al's route structures into Africa. Since flying over Arab lands would endanger both El Al's aircraft and personnel, piston service to Central and southern Africa has been routed through the Gulf of Aqaba, down through the Red Sea straits and then to Salisbury and Johannesburg. With the advent of 720Bs on the route, however, the carrier will fly to Ankara, Teheran, across the Persian Gulf and then to Central Africa. El Al officials contend that a faster aircraft, like the 720B, might easily stray across the narrow Aqaba perimeters where it would be in danger of being shot down. Western route, from Tel Aviv to Benghazi or Tunis and then on to Kano, Leopoldville and Johannesburg is currently being serviced by DC-7C equipment chartered from Sabena. The charter arrangement with the Belgian carrier allows El Al the accessibility to North Africa that it might not ordinarily be assured flying aircraft in its own markings.

Major Problems

El Al, the relatively new airline of a relatively new nation, must accept as a way of life a series of unique problems and self-imposed restrictions—ranging in scope from the dictates of religious canon to the binds imposed by Israel's hostile neighbors—that might cow some of its larger competitors. These include:

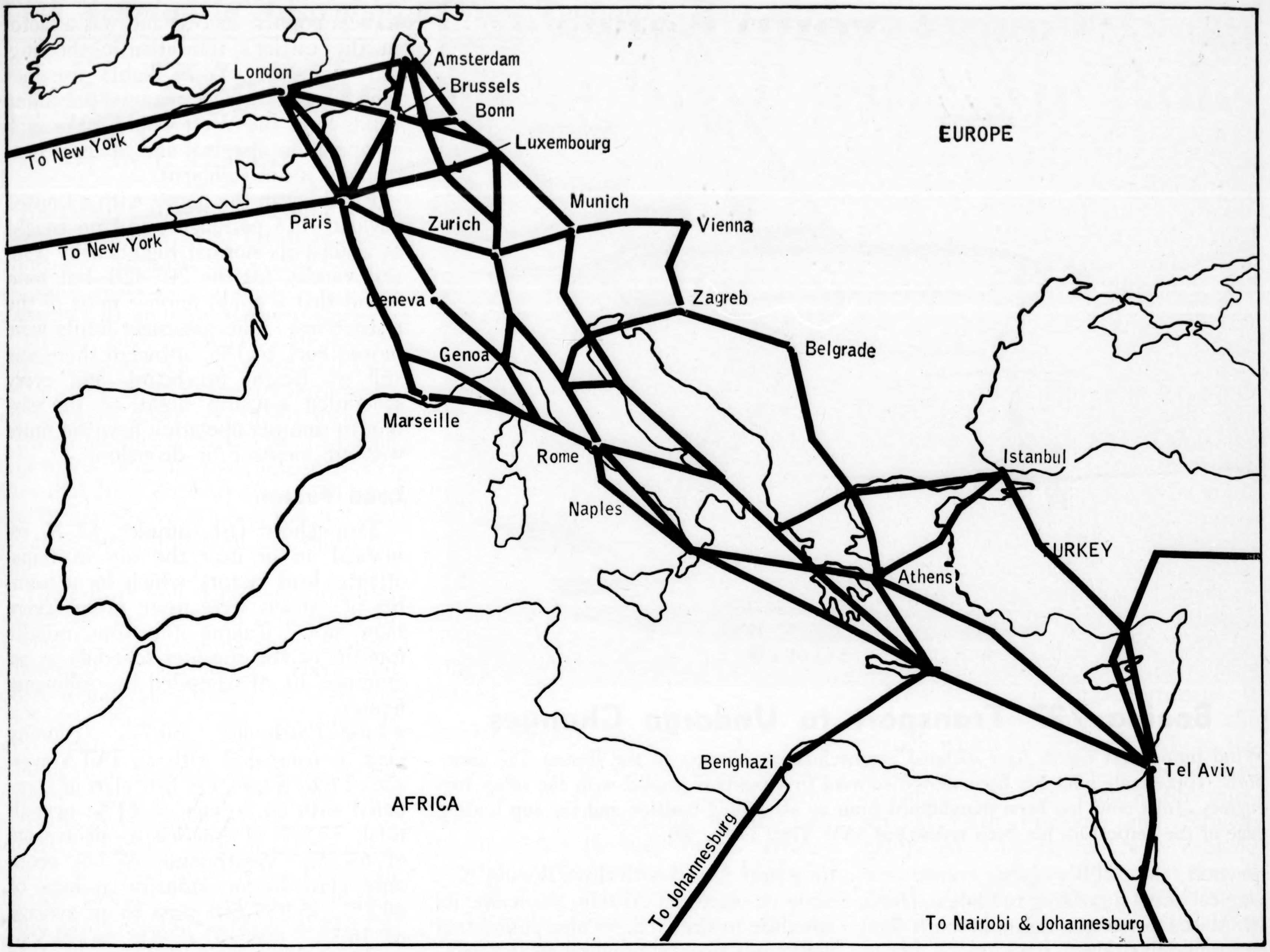
- **Routes must be carefully laid out,** sometimes at a competitive disadvantage, to avoid flights over the territories of its immediate neighbors, which do not formally recognize the existence of Israel, much less that of an Israeli airline, and are ready to fire upon any intruder.
- **Religious law prohibits** operation on the Sabbath—from sundown Friday to dusk on Saturday—or during high religious holidays, a complication that effectively trims El Al's flying year to an average of 290 days.
- **Demands of religion** also make it necessary to install two separate kosher galleys aboard each plane, one for dairy products plus the utensils and plates on which they are to be served and another for meat produce, at a cost in payload of about one-and-one-half tons per aircraft.
- **El Al, as a national airline,** must make its purchases within Israel whenever possible, although sometimes at a cost seven-to-eight times greater than what it would have been required to pay for the same item had it been purchased elsewhere.. Currency regulations under which El Al receives the official rate of 1.80 Israeli pounds to the U. S. dollar as opposed to over two pounds on the open market also cuts into its actual revenue.

Other Problems

The range of problems extends on downward to such matters as recognizing that the majority of the stewardess candidates, most of whom received a substantial portion of their upbringing in the atmosphere of a pioneering new nation fighting for its existence or in the concentration camps of a Nazi Europe, must undergo extensive training to meet El Al standards and needs.

This tiny nation of the Middle East also is well off the traditional heavy lanes of air travel, and outwardly the existence of a national airline would seem to be more a matter of prestige than of profit.

Yet, El Al is making a respectable showing—a profit of about $270,000 in Fiscal 1960/61 as opposed to $30,000



EL AL will make twice-a-week round-trip flights to Frankfurt next summer, marking its first entry into that international terminus. Flights to Istanbul will be stepped up from three to four a week; to Rome from five to seven; to Zurich from three to four; to Amsterdam from one to two; to Paris from five to six under a new agreement concluded last month.

the previous year when it had no turbojet transports of its own—and its outlook seems bright, barring, of course, a tourist-upsetting increase of tension in Europe or in the Near or Middle East.

The reasons for this success are varied, including tight maintenance and operational schedules, a high utilization of aircraft within its 290-day framework, a strict, no-excess allocation of manpower and a high per capita production—the third highest among IATA carriers last year on similar routes.

Possibly as important is the well appreciated fact here that persons of Jewish faith tend to favor El Al for sentimental reasons and will select it over other carriers whenever possible. Referring to the fact that El Al and Aer Lingus (AW Oct. 2, p. 38), enjoyed more success than most on their transatlantic routes last summer, one official here says:

"The Jews and the Irish tend to ride their own national airline, if possible, no matter where they live now. This tendency may not be so great in other peoples."

Another factor is that Israel, as the land of the Bible and home of Judaism and Christianity, is proving to be a strong magnet for pilgrim and ordinary tourist alike. Tourist traffic to Israel has been climbing at a rate of 20-25% a year, reaching a total of 135,000 persons last year. Most of these came by air and, of those who fly, El Al carries an estimated 55-60% of the total. Overall, El Al boarded 122,155 passengers in Fiscal 1960/61 as opposed to 100,376 the previous year and 40,451 in 1956/57.

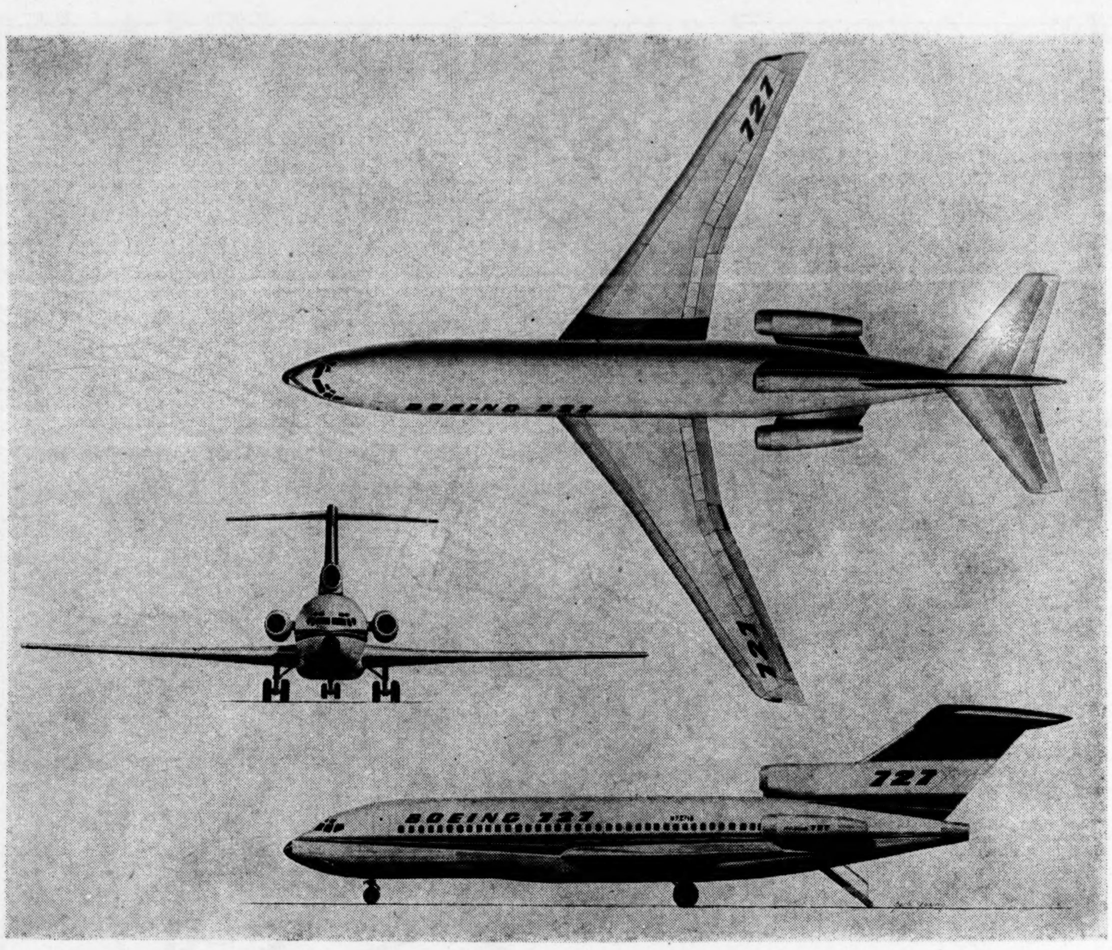
Menachem Cohen, the carrier's deputy commercial director, estimates that 95% of El Al's traffic—transatlantic, European, Middle Eastern and African—has Israel as its hinge. "Our pure European traffic," Cohen says, "is really very small. A passenger may fly to London first [from the U. S.] and spend a week there, but then he will come on over to Israel. . . . If our share of incoming and outgoing traffic from Tel Aviv drops much below 55-60%, we start screaming."

To maintain this average by matching or exceeding the services offered by its competitors is one of the primary reasons behind El Al's swing to an all-turbine operation at an accelerated pace.

The last two Lockheed Constellations on hand were retired on Oct. 15 at the close of the summer schedule, and two of the airline's four Bristol Britannia 300 turboprop transports will be phased out with the beginning of the summer schedule on June 1. Their successors will be two medium-range Boeing 720Bs (AW Dec. 4, p. 41), over the majority of the European routes. The 720Bs, one scheduled for delivery in March, the other in May, also will take over El Al's once-a-week service to points in Africa which are now serviced on a charter basis for El Al by Sabena Belgian World Airlines with Douglas DC-7C piston equipment.

To avoid hostile Arab territory around Israel's frontiers, and because of the aircraft's range limitations, the DC-7C now flies a tortuous course over this route by way of Tunis or Benghazi; Kano, Nigeria, and Leopoldville. The 720B, with greater range, must also follow a circuitous course, skirting Syria, Iraq and Saudi Arabia by way of Teheran, then over the Arabian Sea to Nairobi, Kenya.

From the commercial point of view,



Boeing 727 Transport to Undergo Changes

Wind tunnel test results have dictated engine location changes in the Boeing 727 transport. Top engine inlet has been moved forward to a position parallel with the other two engines. Inlet cowl has been straightened from an aft-slanted position and the top leading edge of the vertical fin has been redesigned (AW Dec. 11, p. 40).

however, the 720B's zig-zag course is a "logical" one, according to Cohen, since El Al has passenger rights at both Teheran and Nairobi.

The third of three Boeing 707-420 transatlantic jets will be delivered early next year and utilized in bolstering Tel Aviv-New York service, both direct and via Europe.

The two Britannias still in use—and these may be retired after next summer's schedule is complete—will augment the 720Bs' European schedule and be placed on flights into nearby Nicosia, Cyprus, and to Istanbul. They also will be used for non-scheduled and group charter flights although, probably, not across the Atlantic.

While 720B and 707 crews will be qualified to fly either aircraft, Britannia pilots will not be available for service aboard the Boeings, which normally serve New York, and crew tieups for a single turboprop flight to the U. S. could be prohibitive for an airline with a total of 1,955 employes, including 587 located in overseas branch offices.

Minimum use of the Britannias next summer is largely dictated by the competition stemming from the other international airlines flying into Tel Aviv on a regularly scheduled basis. Of the 10 competitive carriers, nine are using pure jet equipment on their Israeli schedules. The tenth carrier, KLM Royal Dutch Airlines, serves Tel Aviv with Lockheed Electra turboprop equipment.

In its 1962 summer schedule beginning June 1, and with three Boeing 707-420s in place, El Al will accelerate its schedule to the U. S. to nine round-trip flights per week as opposed to last summer's high of seven, including one 10 hr. 50 min. nonstop run on the 5,600-mi leg from New York to Tel Aviv.

Outgoing flights—and all but the once-a-week direct New York-Tel Aviv run—will be channeled through European ports, including Rome, Paris, London, Amsterdam and Athens.

European Stops

Maximum number of European stops on any one transatlantic flight is two, with the primary idea of picking up rather than off-loading passengers after the comparatively short revenue-producing legs between Israel and the Continent.

Within Europe, El Al next summer will begin twice-a-week round-trip service to Frankfurt, marking its first entry into this international terminus. It has been scheduled into Munich on a regular basis for some time.

Flights to Instanbul will be stepped up from three to four a week; to Rome from five to seven; to Zurich from three to four; to Amsterdam from one to two; to Paris from five to six under terms of a new agreement concluded last month.

The once-a-week nonstop flight from New York to Tel Aviv, discontinued during the winter schedule, was inaugurated last summer after the arrival of El Al's first two 707-420s. It proved to be a popular success and was a factor in the carrier's transatlantic showing. Tel Aviv-New York flights are not scheduled for two reasons—prevailing winds from the West would make such an operation marginal and the passenger demand is not sufficient.

El Al began the flights with a limited payload—115 passengers and no freight as against its normal high-density 156-seat version for the 707-420—but soon found that it could remove most of the restrictions. The passenger limits were moved back to 156, although there was still no freight on board, and every scheduled nonstop flight of the six-month summer operation flew the route without incident or diversion.

Load Factor

Throughout last summer, El Al remained on or near the top in transatlantic load factors, which for a number of carriers were more often severe than not. Taking the four middle months of the summer schedule as an example, El Al compiled the following figures:

- **June**—Eastbound, 80.7% economy class as compared with an IATA average of 69.2%; 48.9% first class as compared with an average of 44%; over-all total, 75.8% as opposed to an average of 65.2%. Westbound, 67.3% economy class to an industry average of 40.1%; 38.9% first class to an average of 36.3%; over-all, 62.8% to 39.5%. El Al ranked third eastbound and first westbound among the IATA carriers for the month.
- **July**—Eastbound, 83.8% economy class to an average of 60.2%; first class 63.2% to an average of 36.3%; over-all, 80.7% to 56.6%. Westbound, 45.9% economy to an average of 51.6%; 18.7% first class to an average of 33.7%; over-all, 41.8% as compared with 48.9%.
- **August**—Eastbound, 49.3% economy to an average of 38.3%; 33.7% first class to an average of 28.6%; over-all, 46.9% to an average of 36.8%. Westbound, 89.1% economy class to an average of 71.3%; 52.4% first class to an average of 35.7%; over-all, 84.1% to an average of 66%. El Al was rated first in eastbound load factors for the month.
- **September**—Eastbound, 63.1% economy to an average of 38%; 35.1% first class to an average of 36.4%; over-all, 59.6% to an average of 37.8%. Westbound, 76.8% economy to an average of 68.8%; 31.1% first class to an average of 35%; over-all, 70.2% to an average of 65.1%. Again, El Al was tops in eastbound load factors.

(This is the first of two articles about El Al Israel Airlines. The second will appear in a subsequent issue of Aviation Week.*)*

Civil Aviation in Australia and New Zealand—Part IV:

New Zealand Seeks Big Pacific Air Role

By L. L. Doty

Auckland—Full development of South Pacific air routes with Tahiti as a key point and Australia, U. S. and Canada as prime markets is the basis of New Zealand's future civil aviation policy.

Unlike Australia's civil air policy, which is global in concept (AW Dec. 11, p. 43), New Zealand considers its air transport role as essentially regional. This philosophy is backed by a growing conviction within government circles here that New Zealand must soon exercise its prerogative as a political and economic power throughout the South Pacific.

There is, in fact, some irritation over claims by the U. S. to a number of Pacific islands including the Tokelaus, Manihiki and Rarotonga. These and other islands are claimed by both the U. S. and New Zealand, and there is discontent over what New Zealanders consider the arbitrary use of many Pacific territories by the U. S. for such activities as satellite tracking.

New Zealand's commercial interests extend westward through the Pacific to North America. Although it is not blind to the trade potentials of the Far East and Southeast Asia, New Zealand does not consider itself as absolutely related to Southeast Asia as does Australia.

It describes itself as a leading member of the South Pacific region, politically, economically and from the standpoint of defense and technical and administrative assistance.

Expansion Plans

Thus, New Zealand's civil air policy is founded on national goals, since overall strategy calls for a strong civil air arm that parallels and supports the economic interests of the nation. Plans are firm to activate this policy by expanding air routes of New Zealand's flag carrier, TEAL (Tasman Empire Airways, Ltd.), beyond the present island-hopping "Coral Route" between Tahiti and New Zealand and the Tasman Sea operation.

The ultimate goal is a network of routes which will include Fiji, Samoa, Cook Islands, Tahiti, Honolulu and terminal points in Vancouver, San Francisco and Los Angeles. The proposed system will, of course, create new competition on Pacific travel but it will also produce the prospect of a well rounded, three-class air transportation service throughout the Pacific.

This service would include the long-haul transpacific services provided by Pan American World Airways; TAI, the French airline; and Qantas Empire Airways. Regional operations would be operated by TEAL, those planned by TAI (AW Nov. 6, p. 43) and, on a smaller scale, by South Pacific Air Lines. Short-haul feeder services are now being conducted by such airlines as Fiji Airways (AW Nov. 13, p. 47), Hawaiian Airlines (AW Nov. 16, 1959, p. 43) and Aloha Airlines (AW Mar. 21, 1960, p. 43).

Key to such an operation is Tahiti. Tahiti is a focal point on a great circle route between Los Angeles and New Zealand. It is an almost indispensable factor in the expansion of tourist traffic beyond the well-established Hawaiian market. It is a vital link in the economic chain of island trade. To New Zealand, it is a valuable export market, which is worth approximately $2.5 million annually.

Tahiti Rights Sought

Pan American is waging a vigorous campaign in the current Civil Aeronautics Board Transpacific Route Case to win rights through Tahiti. Determination of Qantas to gain a foothold in Tahiti has become a national issue in Australia. Hawaiian Airlines is also seeking regional rights within the Pacific, including Tahiti, with Honolulu as the hub of a system extending from the Far East to the U. S. mainland.

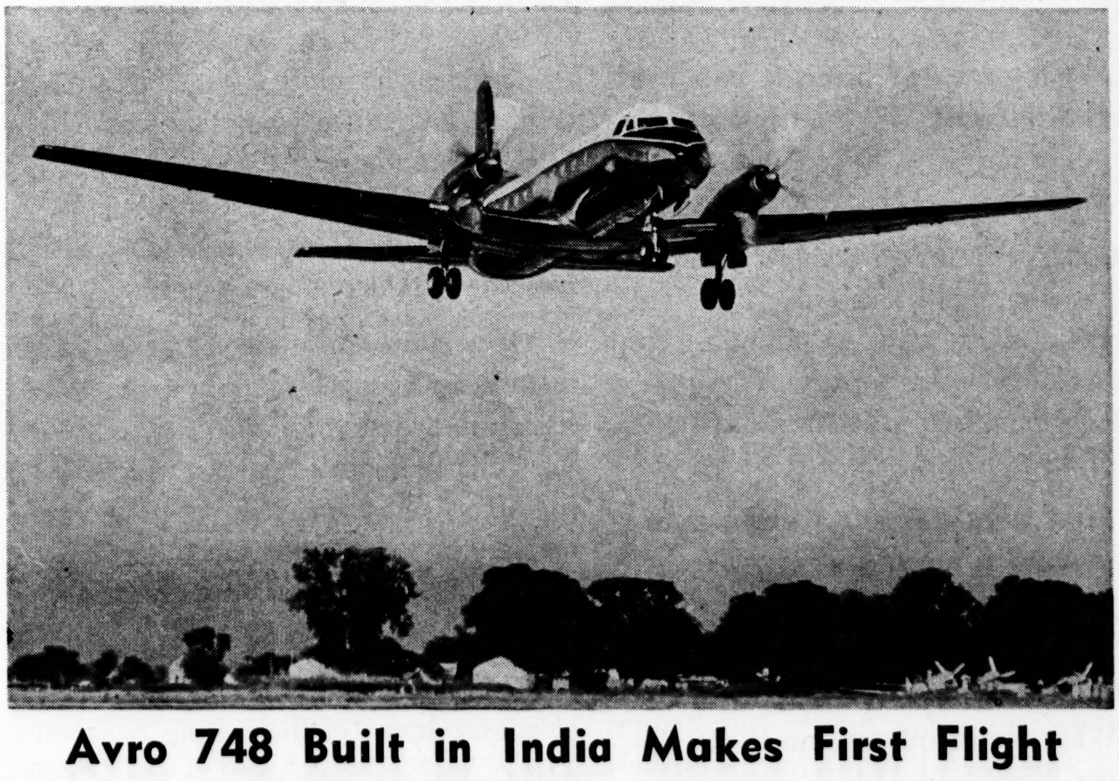
At present, only TAI serves Tahiti on a transpacific route. And TAI, which competes with the sole U. S. company serving Tahiti—South Pacific Air Lines—plans to inaugurate an inter-island service similar to TEAL's Coral Route. South Pacific operates a once-a-week service between Honolulu and Papeete.

French Position

With such a firm grip on South Pacific traffic—both Qantas and Pan-Am openly admit that TAI's Tahiti stop is diverting traffic from them—the French cannot be expected to be overly generous in welcoming new competition into Tahiti. Both Australia and and the U. S. are in fairly good bargaining positions to break down French resistance to new competition, although both are dependent upon the CAB for entry (AW Dec. 11, p. 43).

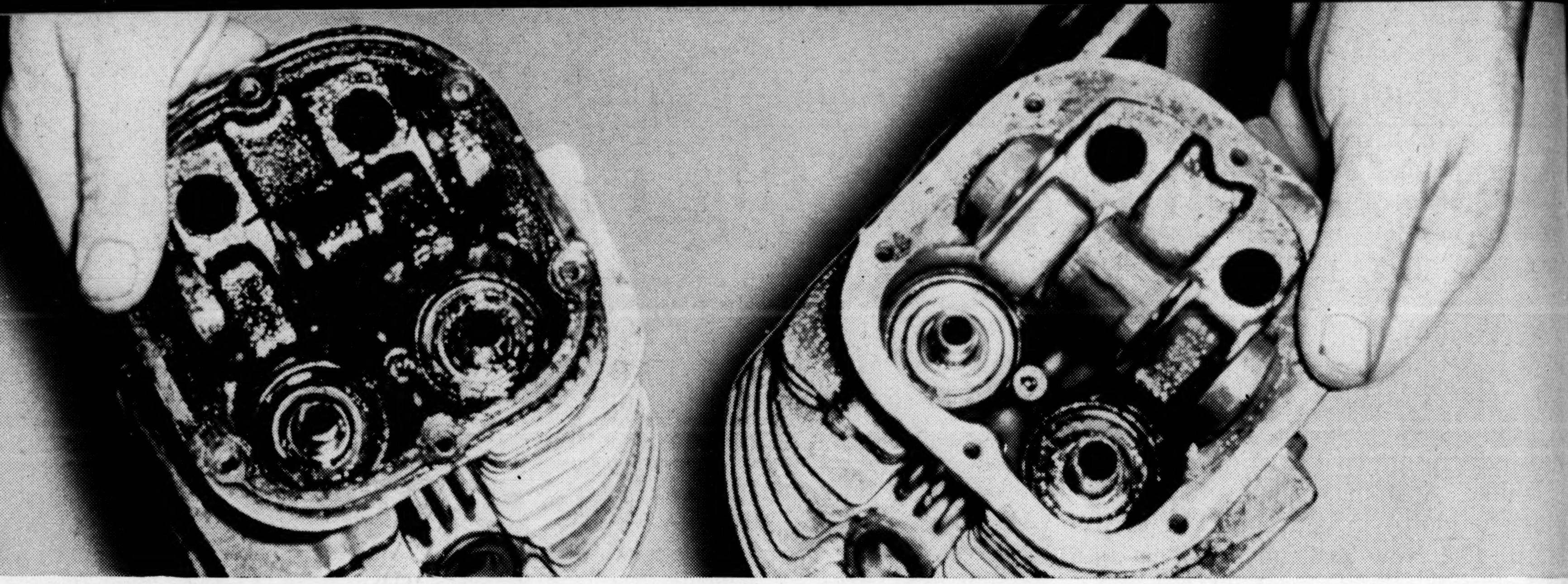
New Zealand is not so fortunate. It has an interim agreement with the French which authorizes TEAL to terminate in Papeete. But it has little to exchange with the French for unrestricted Fifth Freedom and through rights. As a result, the New Zealand government and the airline fear that, if TEAL should win traffic rights as expected, rigid frequency restrictions would be imposed that would all but nullify the value of operating through Tahiti.

Since Tahiti is a key point in TEAL's expansion program, New Zealand probably will be forced to accept the restrictions. In such an event, it is highly



Avro 748 Built in India Makes First Flight

First Indian-built Avro 748, manufactured at the Aircraft Manufacturing Depot in Kanpur, was aloft 30 min. on its first flight recently. The test was made before top-ranking Indian defense officials, including Defense Minister S. V. K. Krishna Menon. The aircraft was piloted by Sqdn. Ldr. Kapil Bhargava.



Dramatic proof of AeroShell Oil W stability. Rocker box section (left) ran for 250 hours using a good straight mineral oil. Rocker box (right) ran over twice as many hours on AeroShell Oil W. Note remarkable cleanliness.

BULLETIN:

Shell answers the ten questions you might ask about AeroShell Oil W—world's first non-ash dispersant aircraft oil

Less oil consumption. Longer intervals between engine overhauls. Easier starting, faster warm-up, reduced wear on piston rings, cylinder bores, cam lobes, lifter faces, gears and bushings.

All these benefits have been obtained with new AeroShell® Oil W. Here, in handy question-answer form, are the facts.

1. What types of aircraft can use AeroShell Oil W? Piston engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special additives that help keep tiny, ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed until they burn.

3. How does this effect engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. *Your engine runs more efficiently, parts last longer.*

4. What about oil consumption? Because AeroShell Oil W means decreased wear and a cleaner engine, you can expect less oil consumption.

5. Can AeroShell Oil W reduce my maintenance costs? If you have been using a straight mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Reason: your engine runs cleaner and cooler. Oil consumption is less. Thus, you can extend intervals between engine overhauls.

6. How does this new oil respond from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thickening of the oil when cold, yet provides outstanding lubrication when hot. Result: *easier starting, faster warm-up.*

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had millions of engine hours of flight time.

8. Where is it available? At Shell Aviation Dealers everywhere. *Any* dealer will stock AeroShell Oil W if you ask for it.

9. Can I add AeroShell Oil W as a make-up oil? Yes. It is compatible with all piston engine oils now being used.

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SHELL

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likely that when it renegotiates its old agreement with the U.S., which has never been used by TEAL, it will ask for rights to serve Tahiti and Hawaii alternately as a means of maintaining a steady flow of schedules to the U.S. mainland.

TEAL's prime mission is to serve New Zealand's interests and the airline is not overlooking the importance of tourist trade. And, the regional policy of the government fits neatly into the airlines' plans for attracting tourists.

The airline recognizes that, second to Australia, the U.S. is its most potentially profitable source of tourists. It also recognizes that, despite the unmatched attraction of New Zealand to tourists, the great distance between the U.S. and New Zealand are likely to deter tourist traffic in any large volume.

TEAL, therefore, once it begins service to the mainland of the U.S., will sell the entire Pacific region as a package. It will not concentrate on New Zealand or Tahiti but will pitch its sales campaigns to all Oceania: most of the Polynesians triangle with Honolulu at the apex, Tahiti and New Zealand at the base, and with Samoa, Fiji and the Cooks as inner links.

A limiting factor in the development of tourist traffic in New Zealand has been the shortage of hotel space, although there are signs of improvement in both the standards and capacity of hotels. Expansion of motel facilities in areas served by TEAL is helping to fill this gap, although hotel accommodations in New Zealand gateways, Tahiti and other areas on the Coral route are still inadequate.

More than passing interest has been given to the possibilities of expanding routes into Japan. New Zealand's volume of exports to Japan is approaching that to Australia, and the balance of trade with Japan is favorable to New Zealand, which is not true in the case of Australia.

Development of such a route structure poses several serious problems. New Zealand is far more remote from the Far East than a casual reference to a map might suggest. The most logical route would be through Australia, Singapore and Hong Kong.

New Zealand has full rights to operate into and through Australia, but it would be forced to negotiate traffic rights through Singapore and Hong Kong and rights into Japan before the route could be considered operationally and economically feasible. To establish a route directly northward through a chain of islands such as the U. S. Trust Territories would not be practical because of the low traffic potential in most of these areas.

However, if trade with Japan continues to expand, as most authorities here feel it will do, then TEAL will be required to extend its routes northward into the Orient.

Halaby Accident

Washington—Federal Aviation Agency inspectors who processed the paperwork on FAA Administrator N. E. Halaby's taxiing accident here (AW Nov. 13, p. 25) have categorized his wing tip scrape with a United Air Lines Viscount as "careless operation of an aircraft."

Full report of the incident has been prepared and forwarded to the Agency's Eastern Region headquarters in New York, where FAA enforcement officers will decide whether to fine Halaby, reprimand him or drop the matter entirely.

Halaby, who holds a commercial pilot's license, assumed full blame.

A major problem to TEAL's expansion program is the issue of cabotage—the undefined but fully-recognized law that prevents the carrier of one country from picking up traffic in another country and setting it down in the same country. Honolulu is a sore spot to all foreign flag carriers operating in the Pacific because cabotage prevents them from carrying traffic on the long-haul Hawaii-mainland segment, the most lucrative leg of all Pacific routes. TEAL will be faced with similar cabotage restrictions on the American Samoa-Honolulu segment of its routes.

Materialization of TEAL's future plans depends on the purchase of turbojet or turbofan aircraft. Acquisition of this equipment depends, in turn, on the completion of the new international Mangere airport to serve Auckland. At present, New Zealand has no airport adequate to accommodate jet equipment, and thus is served only by propeller aircraft.

The new Mangere airport here is slated for completion in 1964. At that time, TEAL's fleet of three Lockheed Electras will be replaced by jet aircraft.

As a member of the British Commonwealth—and it is apparent that New Zealanders feel much stronger ties with England than do Australians—it is quite likely that New Zealand will favor British aircraft manufacturers in selecting jet equipment, even though the aircraft may not be totally suited to TEAL's over-all needs. The British Aircraft Corp. VC.10 model and the de Havilland DH.121 Trident have been under serious study by TEAL engineers.

If, on the other hand, Britain enters the European economic community, New Zealand may feel it more beneficial to look to the U.S. market for its new fleet. As it is, TEAL is particularly interested in the Boeing products because of the wide choice of models available, and has also analyzed the Douglas DC-8, the Convair 880 and 990 transports and the Sud Caravelle.

Presently, the airline does not feel that it will be in a position to move into supersonic operations when the supersonic transport becomes available. As a result, the aircraft it does purchase for inauguration in 1964 will be operated on a long-term basis.

TEAL is now a fully New Zealand-owned airline. In April, agreement was reached to purchase Australia's 50% interest in the company to give New Zealand full sovereignty over the airline. At the same time, a bilateral air transport agreement was signed with Australia to permit Qantas to operate the Tasman Sea route.

Under this agreement, TEAL will be entitled to "substantially more than half" the traffic available on the routes between Melbourne, Sydney, Brisbane and Auckland; between Sydney and Wellington; and between Sydney, Melbourne and Christchurch. Initially, Qantas will be entitled to 30% of the traffic on these routes and, after April, 1962, 40%.

This arrangement will be reconsidered when jet equipment is introduced on the Tasman Sea routes. Meanwhile, it is very possible that TEAL will enter into pooling agreements on the Pacific routes with BOAC and Qantas. Exploratory talks with BOAC indicate British interest in such an arrangement, particularly since TEAL holds such valuable landing rights in areas outside BOAC's realm.

Purchase of TEAL by New Zealand did not have full government support. A strong faction within the government not only resisted the proposed transaction but fought to sell New Zealand's share in the airline. The risk and problems of operating an international airline apparently seemed insurmountable to many politicians.

TEAL has shown a profit in 17 of the 21 years it has been operating. Solent flying boats served the airline exclusively during the four years losses were recorded. The last of the flying boats was retired last year.

During the year ended March, 1961, TEAL carried a total of 103,000 passengers to top the 100,000 mark for the first time. Trans-Tasman traffic increased 43% over the same period last year and climbed 14% on the route between Auckland and Fiji. Company load factor, however, dropped from 71% to 63%.

General manager of TEAL is F. A. Reeves. Chairman of TEAL as well as of New Zealand National Airways Corp., which operates a domestic service in New Zealand, is Sir Leonard Isitt, former chief of staff and commander of the Royal New Zealand Air Force.

(This is the last of four articles examining the civil aviation situation in Australia and New Zealand).

TF33

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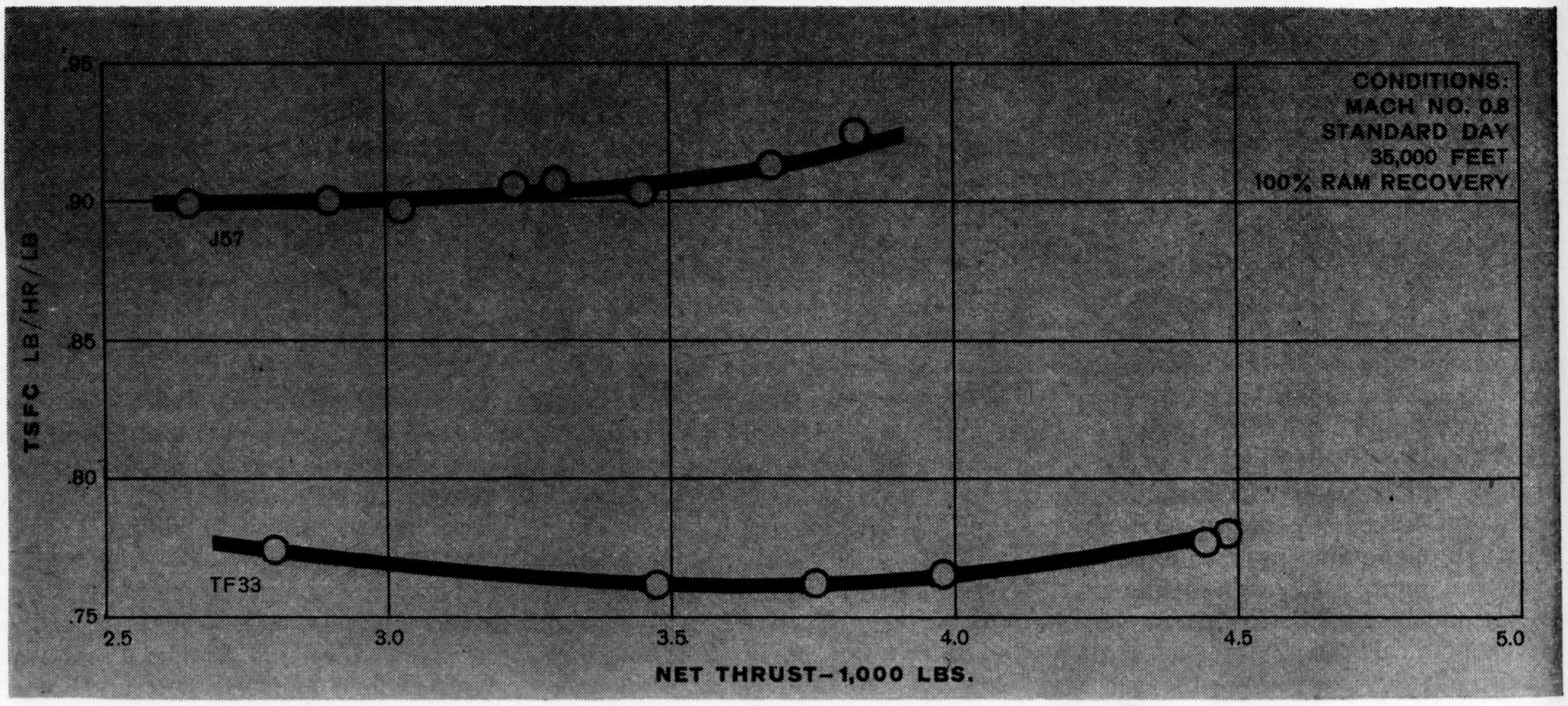
Compared with the conventional turbojet, the Pratt & Whitney Aircraft TF33 turbofan engine has demonstrated a saving of over 15 per cent in specific fuel consumption at comparable cruise thrust. (See chart below.) The effect on operating expense is obvious—less fuel, lower costs. Furthermore, the turbofan's fuel economy is paired with a 22 to 26 per cent lower specific weight than conventional turbojet engines operating today. As a result, the Pratt & Whitney Aircraft TF33 makes possible increased payload, and more than 20 per cent greater range.

ALTITUDE PERFORMANCE COMPARISON OF J57 TURBOJET AND TF33 TURBOFAN



PRATT & WHITNEY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORPORATION

Pan American, ALPA Are Urged To Adopt Feinsinger Formula

Washington—White House determination to make maximum use of the Feinsinger Commission recommendations in settling airline labor problems was re-emphasized last week when a special presidential emergency board refused to issue specific findings in a dispute between Pan American World Airways and the Air Line Pilots Assn.

Ignoring the parties' demands and counter-demands, the board advised an immediate resumption of neutral fact-finding proceedings, broken off in October, and adoption by the union and airline of the Feinsinger findings on the crew complement dispute between ALPA and the Flight Engineers International Assn. (AW Oct. 23, p. 35).

"We wish to make it plain," the board stated, "that in proposing renewed negotiations and fact-finding, we do not suggest any departure from the Feinsinger recommendations. These recommendations were based upon the most cogent, impartial analysis of the problem and have been strongly endorsed by the President. In our view, it would be inappropriate for any party to adhere to a position in conflict with the Feinsinger report."

The board noted that the scope of the controversy is "too vast," and added that it would be "inadvisable, even dangerous, for the board to attempt specific recommendations on all of these points."

Similar Dispute

Meanwhile, another emergency board investigating a dispute between ALPA and Trans World Airlines was expected to report by the end of last week. The similarity of issues on both airlines has generated industry speculation that adoption of the Feinsinger report will also be a key recommendation in the TWA dispute.

Immediate result of the board's action on Pan American will be to delay any strike action for 30 days. Union officials agreed to resume fact-finding talks and the airline notified President Kennedy that it would accept the recommendations.

The board's recommendations were similar to the attitude taken by another presidential board in a Pan American labor dispute last summer.

In June, an emergency board report on a dispute between FEIA and the airline dismissed discussion of major issues on grounds that it would be impossible to rule on them until the Feinsinger Commission completed its investigation (AW July 3, p. 38).

The board pointed out that neither ALPA nor Pan American has been able to settle contract differences despite lengthy efforts by a neutral fact-finder since February.

The report said: "It seems evident that the lack of success of the fact-finding procedure in 1961 was related to the complex and difficult crew complement issue, which not only constituted a most significant problem in its own right but also is intimately inter-connected with numerous proposals advanced by the association and the company.

"We are convinced that PAA and ALPA will not be able to conclude a renewal agreement until the crew complement and related issues are faced squarely and disposed of along the lines of the Feinsinger report."

The board requested all parties to file a report with the National Mediation Board on Dec. 22 indicating what progress has been made in the controversy.

Firm Cancels Contracts With FAA

Washington—United Science Corp., a Los Angeles manufacturer of electronics equipment, has canceled contracts worth $6,966,000 with the Federal Aviation Agency on the grounds that the FAA made contradictory demands, ordered late technical changes and insisted on unreasonable test procedures.

In a suit filed in U. S. District Court here, United Science, a subsidiary of United Industrial Corp., sought to restrain FAA from acquiring possession of components developed by the company, and some government furnished equipment. The injunction, if granted, probably will last until the over-all question of damages can be settled either in court or informally.

United Science canceled the contracts after FAA claimed liquidated damages as a result of late deliveries. FAA feels that by virtue of progress payments, it owns manufacturing rights to certain sideband generators, VOR components and ILS equipment developed under contract by United.

A two-man FAA team sent to Los Angeles last week to assert Agency claims was denied admission to United's plant.

The company earlier had claimed that despite deliveries worth about $5.7 million, it has yet to receive a first payment. When FAA demands made it impossible to deliver components on time, United sought adjustment through a personal meeting with Administrator N. E. Halaby, who refused the request, the company said.

FAA responded to United's cancellation of the outstanding contracts with a series of telegrams aimed at accomplishing the same purpose, a company spokesman told Aviation Week. Since United's action came first, the company said, it elected to deny FAA access to tools, jigs, drawings and components because inspection might reveal trade secrets and proprietary data.

In the suit, Halaby is named as a defendant along with FAA in order to avert prolonged argument over legal technicalities, United said. According to D. J. Harnett, vice president and counsel for United Industrial, the case may set a precedent in that the government has never been sued by a contractor who terminated his own contract in this precise fashion.

Standard FAA contracts contain "liquidated damage" clauses that penalize contractors guilty of "inexcusable delays" in fulfilling their agreements. Whether United's delays are legally inexcusable apparently is the point at issue before the court.

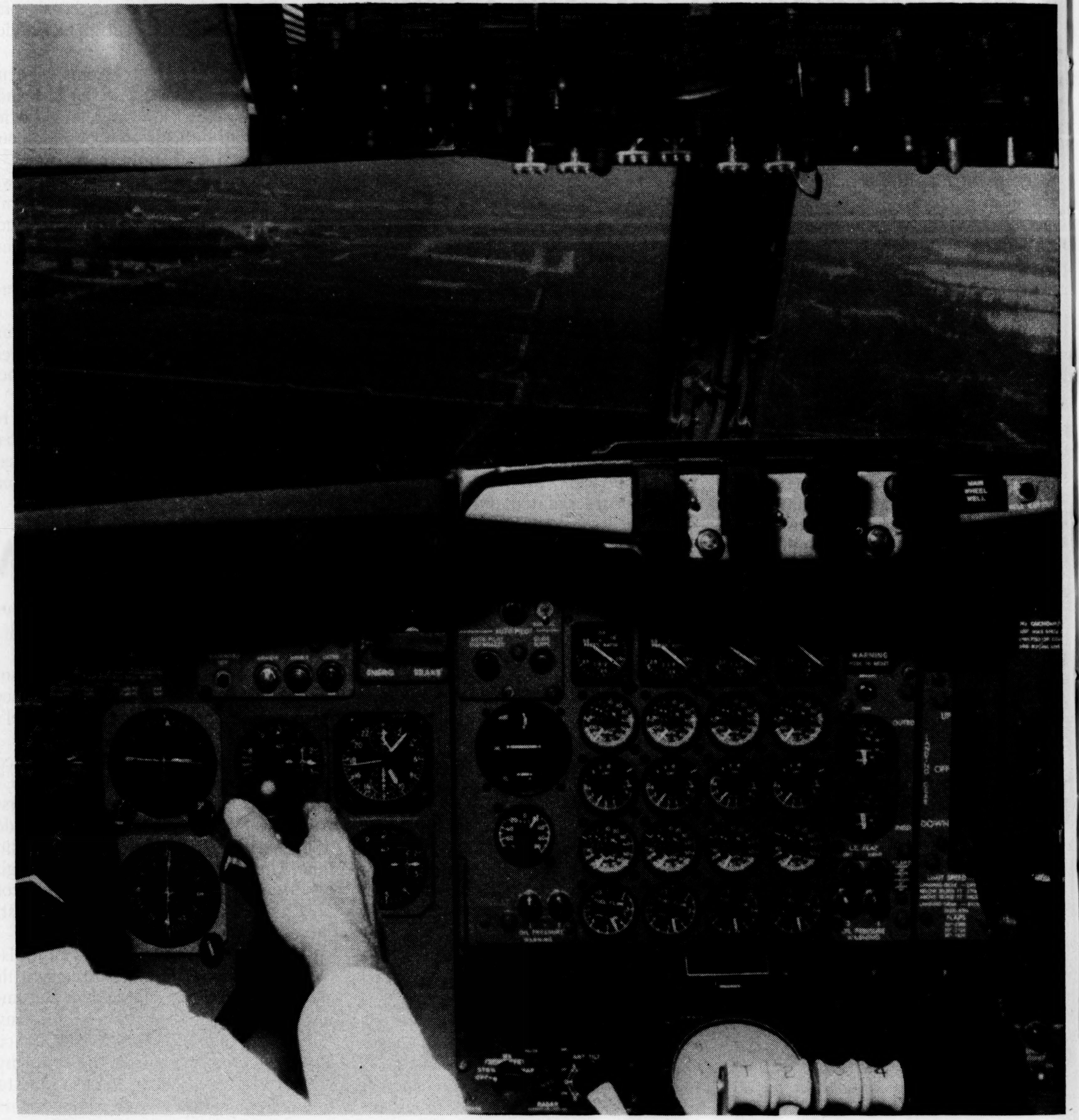
Supersonic Transport Advisers Named

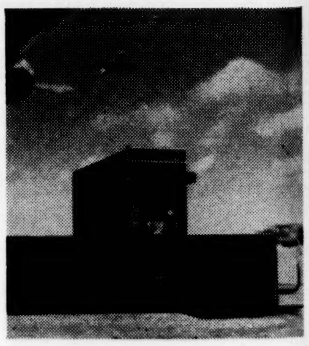
Washington—Federal Aviation Agency Administrator N. E. Halaby has appointed an eight-man supersonic transport advisory group to assist the inter-departmental steering committee that will oversee development of the aircraft.

Retired Air Force Gen. Orval R. Cook will head the advisory group (AW Dec. 11, p. 39), which is composed of Dr. Theodore P. Wright, chairman of Cornell Aeronautical Laboratory; Alvin S. White, North American's chief engineering test pilot; William B. Harding of Smith, Barney & Co.; James Mitchell, vice president of Chase Manhattan Bank; Roger Lewis, executive vice president-administration, Pan American; William Littlewood, American Airlines vice president of equipment research, and Capt. Robert N. Buck of Trans World Airlines.

Over-all supersonic transport policy is to be formulated by the steering committee, with Halaby as chairman and Joseph S. Imirie, assistant secretary of the Air Force for materiel, and National Aeronautics and Space Administration Director of Advanced Research Programs Ira H. Abbott as members.

AIRBORNE ELECTRONICS AT WORK: **SOLID STATE SYSTEMS**





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SHORTLINES

▶ **Aero Safari, S.A.**, a newly organized Mexican feeder airline, is scheduled to begin full operation in Mexico's remote Quintana Roo territory on Dec. 10. Safari will use six-place Lockheed 60 single-engine aircraft to link the territory with key Mexican cities.

▶ **Air France** will open a new route between Paris and Freetown, Sierra Leone, with a weekly round-trip flight beginning Jan. 3. Route will add Las Palmas, Canary Islands to the airline's route system. Other stops on the new route: Bordeaux; Port Etienne, Mauritania, and Dakar, Senegal.

▶ **Braniff Airways'** petition for $3.7-million subsidy for its 1962 international service, excluding Mexican routes, has again been dismissed by Civil Aeronautics Board (AW Dec. 4, p. 50). CAB said the petition did not set forth sufficient detailed justification.

▶ **Civil Aeronautics Board** Examiner Francis W. Brown has recommended in his decision on the New York-Jamaica Nonstop Case that Pan American World Airways serve New York-Newark and Jamaica, and that applications of Delta, Eastern, National and Trans Caribbean be dismissed or denied.

▶ **Federal Aviation Agency** will hold a two-day conference in Washington Dec. 19-20 to discuss runway slush problems in winter jet operations. The conference will be held at the Departmental Auditorium, 9:30 a.m.-4:30 p.m. All segments of the industry are invited.

▶ **Lake Central Airlines** has asked the Civil Aeronautics Board to permit it to serve Chicago and Dayton via South Bend and Ft. Wayne, Ind., and Indianapolis and St. Louis via Terre Haute, Ind. Applications were filed simultaneously with Trans World Airlines' request to suspend service on these routes.

▶ **Saudi Airlines** this month began service on a Jiddah, Saudi Arabia-Hudaydah and Taix, Yemen-Aden route. Initial service will be one round trip weekly.

▶ **Slick Airways, Inc.**, will move general offices and maintenance organization from Burbank, Calif., to San Francisco International Airport. The move, which probably will start in January, 1962, will involve transfers for some 300 employes.

▶ **Trans-Canada Air Lines** will begin DC-8 jet service between Toronto and Jamaica with two round-trip flights weekly, and between Toronto and Nassau with three round-trip flights weekly beginning Dec. 18. The DC-8s will seat 28 first-class and 99 economy.

AIRLINE OBSERVER

▶ Watch for changes within TWA's sales department involving as many as five top-level positions. Among the first is the replacement on Jan. 1 of J. W. Letzkus, West Coast regional vice president who is leaving the company, by Clyde Fullerton, vice president-sales services. Also, organizational changes in company's public relations department are expected as a result of decision to contract with outside consultant for public relations activities.

▶ **American, Eastern, TWA, United, Boeing and Douglas are sponsoring a survey of the travel market conducted by Opinion Research of Princeton, N. J. A major portion of the survey will be study of automobile travelers as a potential airline market. The survey will be conducted house-to-house and results are expected to be available next year. One airline official described the survey as the most comprehensive study of the travel market yet undertaken.**

▶ Look for Civil Aeronautics Board to report the probable cause of history's worst air disaster—the midair collision of a United Air Lines DC-8 and a Trans World Airlines Super Constellation over New York on Dec. 16, 1960—during the latter part of January. The Board originally planned to release the report the middle of this month.

▶ **Air France will soon sell its five remaining Vickers Viscounts to Air-Inter, a private airline serving domestic routes in France. The other six of its original fleet of 11 Viscounts have already been sold—four to British companies, two to Viet Nam.**

▶ Seaboard World Airlines-Lufthansa cargo agreement, whereby Lufthansa would buy 20,000 lb. cargo capacity on six round-trip CL-44 flights weekly between New York and Frankfurt for $4,300 each flight (AW Nov. 6, p. 39), has been approved by CAB subject to the following conditions: that no advertising, aircraft identification or other means be used to indicate that the service is being performed by any carrier other than Seaboard; that Seaboard may adjust its schedules according to sound business practice without prior approval by Lufthansa; and that no Lufthansa cargo representative shall accompany the flights.

▶ **Avro 748 turboprop transport will receive British Air Registration Board certification before the end of this month. Company currently is making minor instrumentation changes to meet Air Registration Board final requirements.**

▶ Russia's highly-touted Tu-114 trans-Siberian service is still operating with minimum flight frequencies almost a year after the run was inaugurated. The double-decked, four-turboprop Tu-114s—world's largest commercial transports—are scheduled for only one flight weekly between Moscow and Khabarovsk this winter. By contrast, 70-passenger, twin jet Tu-104As will make four flights daily over the same route.

▶ **Eastern Air Lines has asked CAB for authority to serve Huntsville and Birmingham, Ala., instead of Nashville-Montgomery on its Chicago-New Orleans route. Eastern said it was acting at the request of the National Aeronautics and Space Administration, which operates the George C. Marshall Space Flight Center at Huntsville and will begin operations at the large booster fabrication center at Michoud, La., early next year.**

▶ TSA-Transcontinental, the Argentine private enterprise airline that opened service between New York and Buenos Aires late in 1958 and now uses Bristol Britannia transports, has suspended international operations and is in the process of reorganizing. The airline has merged with Austral, another private Argentine airline, and international service is expected to be resumed within several months with leased jet equipment. Ultimately, the airline expects to have its own jets. The Britannias hopefully will be leased to other operators and revenues applied to TSA's obligations with Bristol. Sabena has been handling TSA's sales activities in New York.

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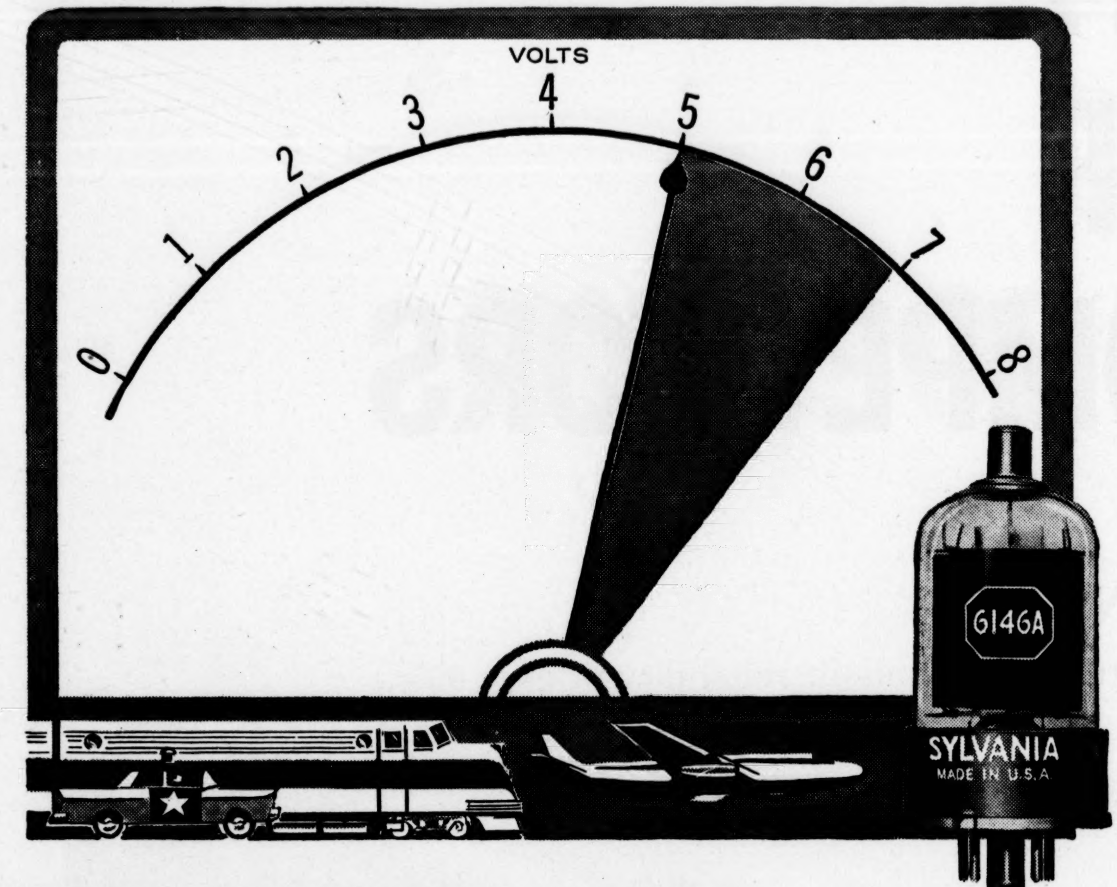

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New Sylvania-6883A (12.6V type), 6159A (26.5V type) deliver 45W power at reduced A-supply of 10V and 21V, respectively

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*Minimum output limit for an individual tube (CCS) measured in a single-tube self-excited oscillator circuit. Conditions: plate voltage—600Vdc; grid #2 voltage—180Vdc; grid #1 resistor —30,000 Ohms; plate current—100 to 112mA; grid #1 current—2 to 2.5mAdc; frequency—15 MC.

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British Cargo Plane Design Needs Cited

London—Adm. Louis Mountbatten, chief of the British defense staff, last week criticized industry design teams for over-concentration on passenger airliner design and failure to develop a simple, rugged cargo plane.

Such a design, he said, has become doubly important in view of impending negotiations for Britain to join the common market and the resultant opening up of a wider market for air freight. In a speech to the Air League, he said:

"Aircraft design teams in most countries, and certainly in the United Kingdom, seem still mesmerized by glamor. . . . The design of a cargo plane with a low ton-mile cost and an economic first cost may be just as demanding as that of a passenger airliner and, if successful, may be far more profitable."

He contended that staff planners should seek a balance between a multiplicity of types of aircraft to eliminate what he called "a vicious spiral leading inevitably to too many eggs in one superlatively finished and impossibly expensive basket."

Mountbatten warned the industry that there would not be enough different types of aircraft to give sufficient work to the number of separate design teams now in existence. The alternatives, in the defense chief's view, are to either split up work among the teams, or even better, to disband selected teams and strengthen the remainder.

Mountbatten backed the continued use of the V-bomber fleet as Britain's nuclear deterrent. He noted that he had no regrets that the country has abandoned a static-based ballistic missile (Blue Streak) as her future deterrent. He said the Avro Blue Steel standoff bomb and Skybolt, fitted to V-bombers, provide a more flexible deterrent.

BOAC Deficit

London—British Overseas Airways Corp. has marked up a deficit of nearly $22 million in the 32 weeks of its fiscal year, as of Nov. 11, according to Sir Basil Smallpeice, BOAC managing director.

When the airline budget was prepared last March, BOAC predicted a surplus of about $1.7 million, but losses mounted despite the fact that costs have remained within budget limitations, he added.

Major causes have been due to a long strike at London Airport last July and a serious slump in BOAC's passenger traffic on its most lucrative route, the North Atlantic. Over-all route load factors are running at 52%, although budget figures were planned on a 58.5 percentile range.

Austrian Airline Continues Growth Pattern

By Edith Walford

Vienna—Austria's national carrier, AUA Austrian Airlines, expects to close the year with significant increases in all sections of its operations, continuing the high growth rate maintained since its post-war revival in April, 1958.

Seats sold during the first nine months of 1961, for example, totaled 115,000 and reflect an increase of 53.7% over the 74,817 passengers carried during the same period of the previous year. From April to December, 1958—the airline's first nine months of operation—passengers transported totaled 28,351.

With corresponding increases in all other traffic categories, AUA is now preparing for the introduction of its first turbojet service by 1964. They are scheduled for operation on some of the carrier's longer routes within its short and medium-range network, which is now confined to Europe and the Middle East and being served by a fleet of seven Vickers Viscount turboprop aircraft.

The Boeing 727, Sud Caravelle, de Havilland 121 Trident and British Aircraft Corp.'s BAC 111 turbojet transports are currently under consideration and, for the moment, the 727 and Caravelle appear to be the strongest contenders for the company's initial order for at least three aircraft. However, according to Felix A. Schalk, managing director of Austrian Airlines, early delivery will be a major condition for any order placed.

Policy of Restraint

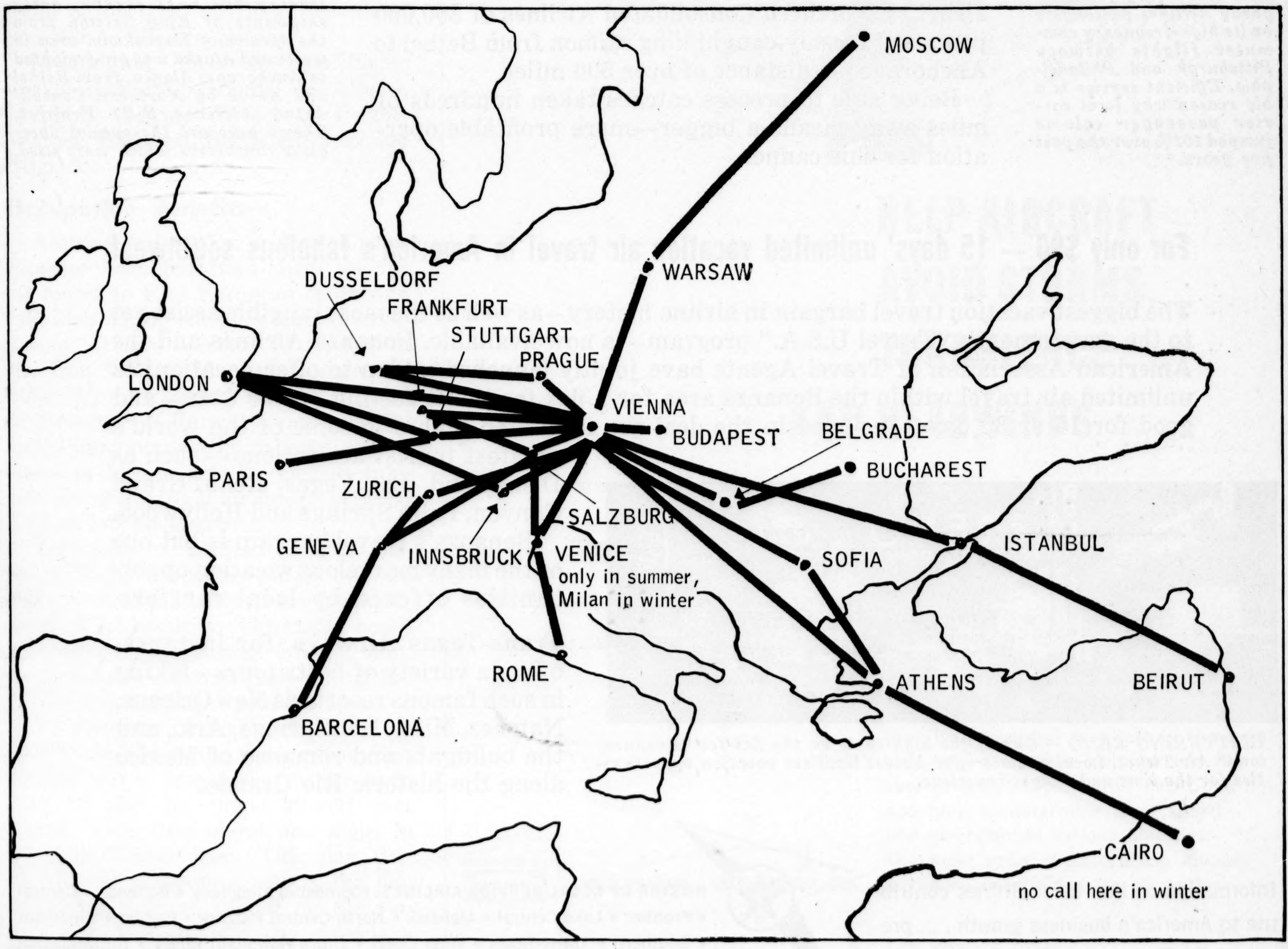
The company's policy of restraint, so far as new investment is concerned, until current commitments can be met has paid off. Continuing this practice, AUA's management says it does not plan to introduce transatlantic service until 1967-68 at the earliest. As yet, Austria has no bilateral agreement with the U.S., and this would have to be negotiated in the interim.

The present AUA Austrian Airlines with a privately owned share capital of about $2.4 million was founded in September, 1957, after a 19-year hiatus caused by World War II. It began its first postwar scheduled service between Vienna and London on Mar. 31, 1958, utilizing four chartered Vickers Viscounts.

At the moment, an increase in the company's share capital to approximately $4.8 million is being negotiated. Shares probably will be 50% government-owned with another 30% in the hands of the Austrian counties and communities and the rest held by private enterprise, chiefly banks and industry.

Present employes total 697, including 95 flight and 340 technical personnel.

The fleet of aircraft, for which the government provided the funds, consists of five 56-passenger Vickers Viscount 837s, two 44-passenger Viscount 745s and one Piper Comanche used primarily for pilot training. Delivery of the Viscount 837s, ordered in January, 1960, began in April of the same year and was completed in July, 1960. The Viscount 745s, purchased from Capital Airlines, began service with the



AUSTRIAN AIRLINES' combined domestic and international network covers a total of 8,694 unduplicated route miles.

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Integrated local and trunk airline service speeds flights to intermediate and smaller cities

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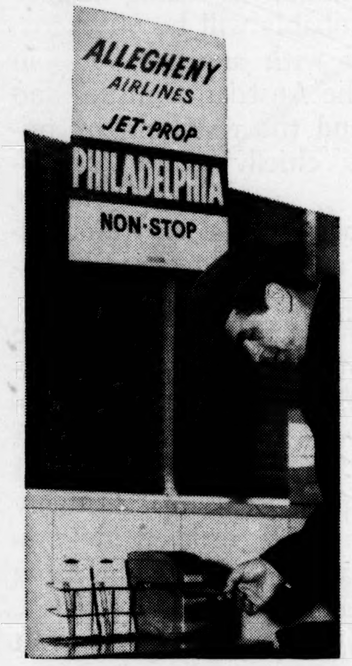
Ozark Airlines, in fact, is so oriented to this kind of service that convenient trunkline connections are the dominant factor in its scheduling. Nearly 2,000 passengers use Ozark's services each day and approximately two-thirds are connecting with other airlines.

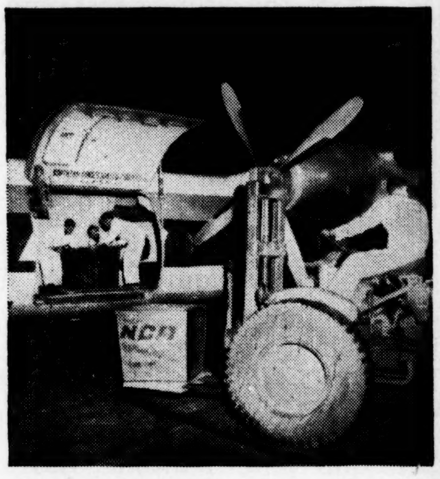


DO-IT-YOURSELF TICKETING saves both time and money for Allegheny Airlines passengers on its high-frequency commuter flights between Pittsburgh and Philadelphia. Efficient service is a big reason why local carrier passenger volume jumped 101% over the past five years.

"Flying Fish" expand operations for Alaskan canner

Proof that low-cost local service air freight is proving a boon to perishable food processors is the recent airlift by **Northern Consolidated Airlines** of 300,000 pounds of freshly-caught king salmon from Bethel to Anchorage—a distance of over 500 miles.

Being able to process catches taken hundreds of miles away means a bigger—more profitable operation for this canner.



AIRBORNE KING SALMON — During the past season, daily shipments of King Salmon from the sprawling Kuskokwim area in westward Alaska was air-freighted to Anchorage, Alaska, from Bethel and Aniak by Northern Consolidated Airlines F-27 Propjet. Shown here are the special fiberglass containers which were used.

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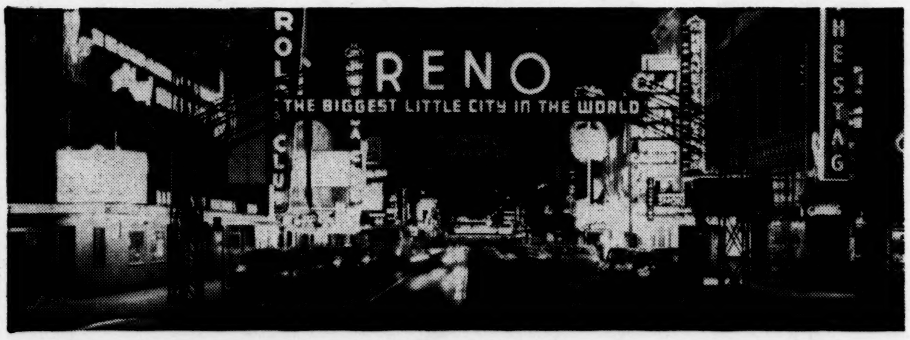
The biggest vacation travel bargain in airline history—as well as the most tangible assist yet to the government's "Travel U.S.A." program—is now available. **Bonanza Airlines** and the American Association of Travel Agents have jointly launched a plan to offer vacationists unlimited air travel within the Bonanza area for a flat fee ticket costing $90 or $160—and good for 15 or 30 days. Included in the deal are unlimited flights to some of the world's greatest tourist attractions—such as Disneyland, Las Vegas, Reno, Grand Canyon, Palm Springs and Hollywood.

Bonanza's travel bargain is but one of the many marvelous vacation opportunities offered by local carriers.

Trans-Texas Airways, for instance, offers a variety of fiesta tours—taking in such famous resorts as New Orleans, Natchez, Miss., Hot Springs, Ark., and the bullfights and romance of Mexico along the historic Rio Grande.



GLITTERING RENO — One of the high-spots on the flat-fee "Bonanzaland" Air Ticket. Local airlines offer almost limitless vacation opportunities for the time and budget-conscious.

Information on how local airlines contribute to America's business growth . . . prepared by Texaco Inc., Aviation Sales Dept., 135 E. 42nd St., New York 17, N. Y.

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Austrian carrier during last spring.

Each aircraft has a crew of five—captain, copilot and three hostesses. AUA's 8,694 unduplicated route mile network connects Vienna with 24 cities in 18 different countries in Europe and the Middle East during the summer flight schedule. This winter, with no service to Cairo, there are a total of 30 services to 23 centers in 17 different countries.

The only domestic round-trip flights are from Vienna to Innsbruck and Vienna to Salzburg. The longest international flight is from Vienna to Beirut. Other round-trips include Vienna-Zurich; Vienna-Geneva-Barcelona; Vienna-Stuttgart-Paris; Vienna-Frankfurt; Vienna-Prague-Dusseldorf; Vienna-London; Vienna-Venice-Rome during the summer and Vienna-Milan-Rome in the winter months. Most of these are operated on a once-a-day frequency at least, some twice a day and a few on a three-times-a-day round-trip basis.

The Vienna-Zurich and Vienna-Frankfurt services are the most profitable on the carrier's network. They average a load factor of up to 98% during the summer flight schedule and, according to a company official, more AUA aircraft than presently available could be operated on these two routes and still be filled to capacity.

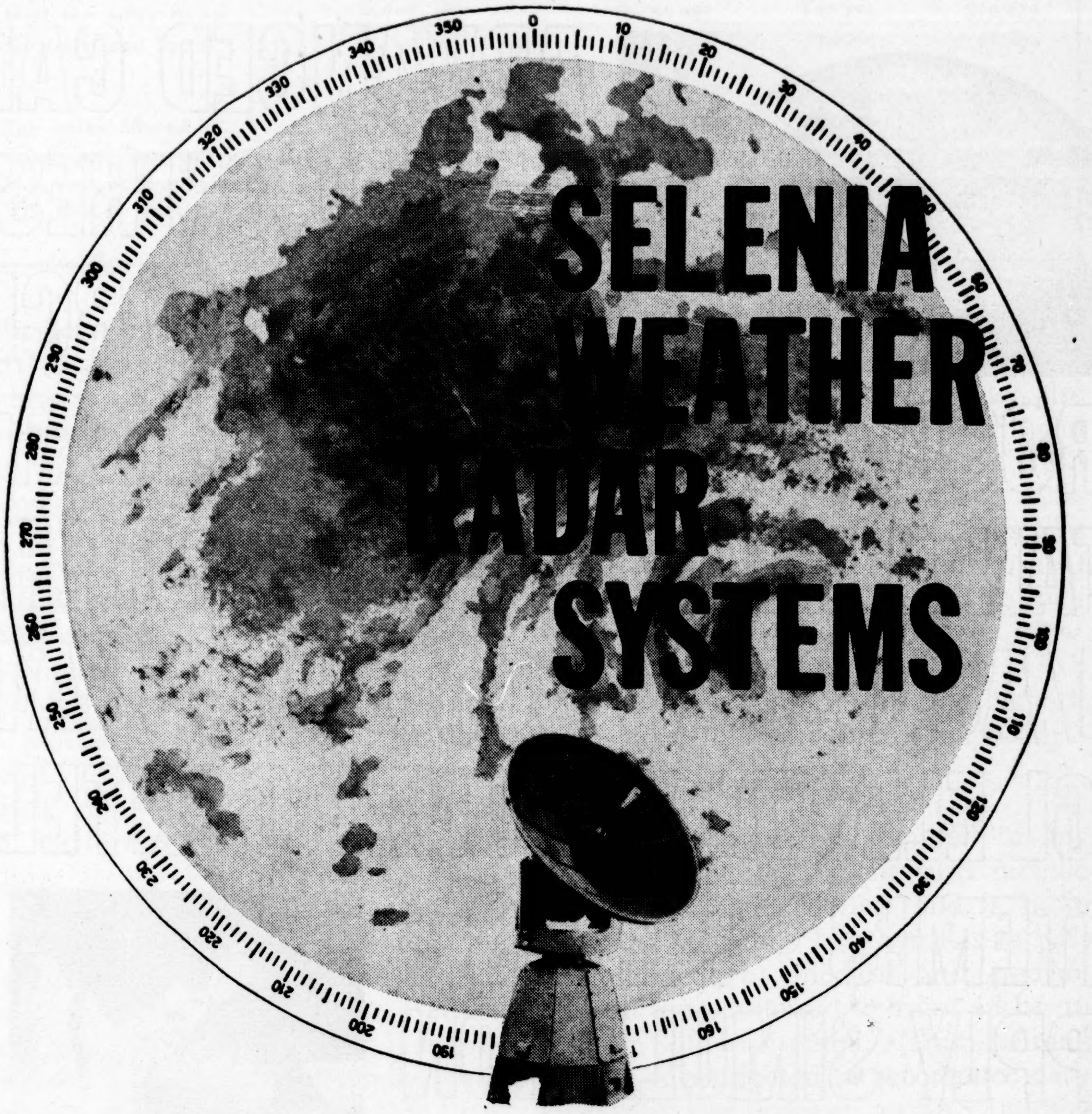
In addition, there are two flights weekly each from Vienna to Athens, Istanbul, Beirut, Moscow, Prague, Warsaw, Budapest, Bucharest, Sofia and Belgrade.

Occupation Benefits

Austrian Airlines has, in fact, in some measure benefited from many of the air routes to East European centers established during Austria's Russian occupation. It now operates 14 services to the Iron Curtain bloc, more than any other Western carrier. Austria, situated in the center of Europe, forms a natural traffic junction and its national carrier, based in Vienna on the Eastern frontier, forms a natural air bridge between East and West Europe.

According to Austrian Airlines' Viscount flight schedule, utilization rate per aircraft is presently in the neighborhood of 7.5 hr. daily. The carrier hopes to achieve a minimum of 6 hr. 30 min. flying time per aircraft daily during the 1961-62 winter flight schedule.

To maintain its flight schedule with only seven Viscounts, the company has worked out a progressive maintenance plan so that no single aircraft ever spends more than about one night in 10 at its Vienna base. This plan, prepared well in advance, shows the employment of every aircraft on the various routes during the day, leaving a margin for possible delays or flight cancellations and allowing for servicing



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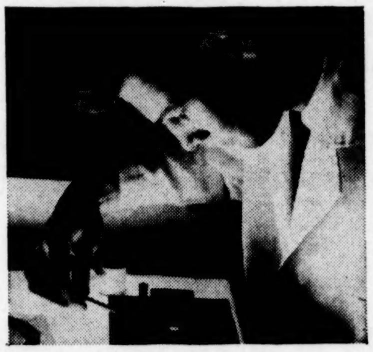

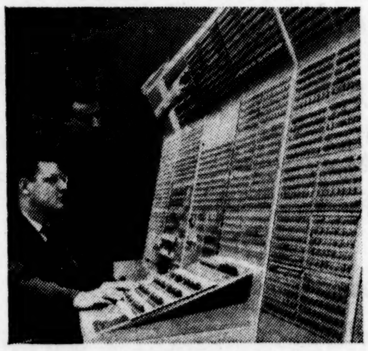

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FIELD ARMY EMERGENCY WARNING SYSTEM • R

and maintenance time en route. For example:

- **Thursday:** Takeoff at 8:30 a.m. from Vienna to Stuttgart-Paris, returning to Vienna in the afternoon. The same aircraft takes off that evening from Vienna for Milan and Rome where it remains overnight.
- **Friday:** Takeoff from Rome in the morning via Milan to Vienna, arriving there at midday. That afternoon the plane goes from Vienna to Warsaw and Moscow where it spends the night.
- **Saturday:** Takeoff from Moscow in the morning for Warsaw-Vienna-Salzburg-Geneva-Barcelona, where it spends Saturday night.
- **Sunday:** Takeoff from Barcelona to Geneva-Salzburg-Vienna and then on to Milan and Rome for the overnight stay again.
- **Monday:** Takeoff from Rome to Milan-Vienna-Warsaw-Moscow for the overnight stop.
- **Tuesday:** Takeoff from Moscow in the morning to Warsaw-Vienna-Salzburg-Geneva-Barcelona for the night.
- **Wednesday:** Takeoff from Barcelona for Geneva-Vienna-Sofia for the overnight stop.
- **Thursday:** Aircraft leaves Sofia for the round trip to Vienna-Innsbruck-Zurich-Geneva. The plane makes an overnight stop in Geneva.
- **Friday:** Takeoff from Geneva for Salzburg-Vienna-Prague-Dusseldorf-Prague-Vienna for the night.

During these nine days, the aircraft normally covers a distance of about 18,630 mi., takes off and lands 82 times and carries an average of 2,000 passengers. The aircraft's crew is relieved en route at least once a day and, on the longer flights, twice a day.

Servicing and maintenance work is carried out during the longer stopovers or at the end of the respective round-trip flight.

Austrian Airlines' first fatal accident occurred Sept. 26, 1960, when a Viscount crashed near Moscow killing 25 passengers and the crew of five.

Maintenance Procedures

Servicing and intermediate checks of both the Viscount airframes and powerplants are done at Vienna Airport by the airline's own technicians. Until now, major airframe overhauls have been turned over to Marshall's Flying School at Cambridge, England, and major overhaul of the Viscount engines to Lufthansa West German Airlines' workshops in Hamburg. New electronic, hydraulic, electrical and Viscount propeller servicing equipment was installed last year and the entire airframe maintenance program, including major overhauls, now will be undertaken by the company's technicians in Vienna, according to the following work schedule:

AUA Austrian Airlines' Growth

	1958	1959	1960
Total miles flown per year	1,041,714	1,457,895	1,929,728
Hours flown	4,885	6,965	9,141
Passengers carried	28,351	72,675	118,551
Freight ton miles flown	168,597	397,291	769,604
Mail ton miles flown	56,487	140,256	310,475
Over-all load factor	25.2%	39.89%	41.4%
	First nine months 1960	First nine months 1961	
Ton miles offered	8,079,575	12,056,000	+50 %
Passengers carried	74,817	115,000	+53.7%
U.S. tons of freight carried	383,624	610,500	+46.5%
U.S. tons of mail carried	183,196	244,200	+33 %

- **Pre-departure inspection** of the aircraft requires two men and lasts half an hour.
- **Inspection** of each aircraft by three mechanics after each 30 hr. of flying.
- **Periodic check** after every 60 flight hr. requiring 36 man hr.
- **Another check** after every 120 flight hr. requiring an average of 350 man hr.
- **Major airframe overhaul** cycle is completed after 3,000 hr.

Major airframe overhaul carried out by Marshall's Flying School has kept each aircraft grounded for approximately two weeks. By undertaking this job itself, the company expects it to require about three weeks initially.

The Viscount powerplants undergo the same frequency of servicing and checking as the airframes, but the engines complete their major overhaul cycle at 2,000 hr. The carrier is hoping gradually to increase the engine overhaul life to about 2,500 or 3,000 hr.

AUA's technical staff also is responsible for the checking and servicing of all Vickers Viscount aircraft of Air France, Alitalia, Lufthansa West German Airlines, British European Airways and Iraqi Airways as well as of the Comet IV turbojets of Middle East Airways serving Vienna. This, together with the carrier's own servicing and maintenance work, is done in its workshops and hangars at Vienna Airport where it also has its own pilot and technical training school.

The first nine of Austrian Airlines' present staff of 31 pilots received their first year's basic pilot training with KLM Royal Dutch Airlines. This was followed by three-to-four months training with the Irish carrier, Aer Lingus, then to Lufthansa West German Airlines for one month of special Viscount training. They qualified for service with Austrian Airlines after a final five weeks of instruction with the Viscounts' British manufacturers, Vickers, Ltd., where originally about 15% of the airline's total technical staff also rounded off their training with a five-week course.

The airline's technicians complete their training on the Viscount servicing and maintenance procedures after about 20 weeks, although they qualify as skilled technicians only after a practical training period of up to two years.

AUA's captains and copilots also must undergo both an efficiency and medical test every six months. Until Austrian Airlines took delivery in 1958 of its own ground simulator, which is fitted with the Viscount's instrument board, its pilots had to complete their training with Swissair in Zurich. Now, under R. H. Kaefer, head of AUA's pilot training center at Vienna Airport, the entire course is conducted locally.

Basic Qualification

Basic qualifications required of any new pilot joining the company include a private pilot's license and a radio operator's license. He then has to pass the subsequent medical and psychological tests, followed by from 45 hr. to 60 hr. of instruction. This training course is conducted in accordance with the rules laid down in an SAS training manual.

A combined SAS-Swissair route manual also is used in the pilot training school, which is kept up to date and revised on a weekly basis. Kaefer is currently building up an advanced pilot training school.

AUA is a member of International Air Transport Assn. In addition, the Austrian airline has signed a number of commercial agreements with other companies covering route pooling and agency pacts. These include Scandinavian Airlines System, Lufthansa West German Airlines, British European Airways, MALEV Hungarian Air Transport, TABSO Bulgarian Civil Air Transport, TAROM Rumanian Air Transport, Air-India, Finnair and Alitalia.

The company has permanent offices in Vienna, Innsbruck, Salzburg, Zurich, Paris, London, Frankfurt, Rome, Stuttgart and Athens. The airline also plans to have its own office in New York by 1962. The company is permanently represented by agents in Dusseldorf, Madrid, Geneva, Venice, Milan, Belgrade, Moscow, Istanbul, Beirut, Prague, Budapest and Barcelona and recently became the general sales agent in Austria of Iraqi Airways.

USAF Sees Need for 3-Man Lunar Rover

By Barry Miller

Three-man, multi-purpose lunar roving vehicle capable of performing such logistic functions as towing, bulldozing, maintenance and repair at a military base on the moon may evolve by 1966 from a study contract the Air Force's Aeronautical Systems Division intends to award early next year.

Industry proposals for the study were requested recently (AW Nov. 13, p. 23) by the Support Techniques Branch, Flight Accessories Laboratory, Aeromechanics Branch of ASD. They are being evaluated now and a decision is due shortly. A companion study, calling for a temporary lunar shelter, or base, which the lunar vehicle might serve as a workhorse, is on bid now.

While modest in size, if not in scope, both efforts underscore emphasis the Air Force is placing on the value of the moon as a manned base for performing military missions like cislunar and space surveillance, reconnaissance, deterrent space weapon systems and the identification and destruction of hostile space vehicles.

Even without a clearly defined military mission on the moon, USAF has over the past several years kept abreast of lunar military potential through a continuing, interrelated series of studies.

Photo Platform

Prominent among these studies was an examination (AW Apr. 27, 1959, p. 26), under SR 183, of lunar observatories (bases) which might provide a platform from which photographic and other optical and electromagnetic sensors could maintain close surveillance of the earth and near space, unhindered by terrestrial atmospheric conditions.

An examination of the lunar strategic weapon system (SR 192) grew from this study. Later, several industry contractors took a close look at a permanent lunar base and the logistics necessary to support it in a follow-on or refinement of SR 192, known as SR 17532. Four SR 17532 studies were completed several months ago by North American Aviation, Martin, General Electric and General Dynamics/Astronautics.

Several related reports on an earth-to-lunar logistic system, conducted under SR 183A, were submitted to the Air Force's Space Systems Division recently. In another study (AW Sept. 28, 1959, p. 26) in this series (SR 182), Air Force, through what formerly was the Ballistic Missile Division, looked beyond the moon at potential moon-to-interplanetary strategic systems.

On the basis of the results of these studies, the Air Force regards a manned lunar base as technically feasible, and attainable by 1969 provided necessary techniques and equipment are developed.

Lunar roving vehicle would be an integral part of the projected lunar base which it might be asked to build at a future date. The vehicle would aid in constructing and then supporting the base, would transport men, equipment and material, and might offer shelter with its own life support system to protect men, if necessary, from solar radiation, micrometeoroids, and other environmental hazards.

Initiate Study

To satisfy these needs, the Air Force has initiated the projected lunar roving vehicle study. Its specific objectives—as outlined in a work statement circulated to industry recently—are to:

- **Define preliminary design** concept for the vehicle. Air Force contends that sufficient information is known about the lunar environment to formulate a preliminary concept, sufficiently versatile to be revised on the basis of information gathered in projected National Aeronautics and Space Administration lunar probes without seriously compromising expected vehicle performance. This includes dimensional outline drawings detailing components and concepts.
- **Formulate a comprehensive research** plan that pinpoints applied research areas that must be tackled so that the vehicle could be constructed by 1966.

As presently envisaged by ASD, the roving vehicle is not to exceed 10 tons and its configuration is to be within a 40 ft. long, 14 ft. diameter cylinder. The final shape and size will be dictated by booster configuration. It is to be a wheeled or tracked vehicle capable of speeds from between 5 and 10 mph. Its minimum range is projected at 250 mi. without refueling or resupply. ASD has specifically ruled out any unconventional locomotion schemes such as walking legs or paddle wheels.

Support Functions

Vehicle may perform support functions for initial establishment of a manned lunar base. It would be expected to:

- **Transport a three man crew** and additional cargo over the lunar surface.
- **Tow or drag** support equipment needed at a lunar base.
- **Bulldoze loose lunar surface** or scoop it for back filling or covering.
- **Manipulate for assembly,** maintenance and repair tasks. Manipulator(s) is to have provisions for manual control by a crew member from within the vehicle and for remote control through a servo control system. Actions of the manipulators are to be remotely monitored.

Vehicle is to be designed to be ready without special assembly operations after soft landing on the lunar surface. It must be capable of functioning through the lunar environment (AW Oct. 2, p. 52). The vehicle must be capable of withstanding the lunar vacuum, temperature extremes, radiation, the shock of a soft-landing and the various conditions encountered en route to the moon.

Air Force is requesting that the vehicle have a life support system capable of sustaining three men for up to seven days.

An environmental control system is to provide a reliable supply of oxygen and protection, maintain satisfactory respiratory pressure and be able to extract impurities from the life supported volume. Men are to be able to enter or leave the vehicle without making elaborate resupply of environmental conditions necessary.

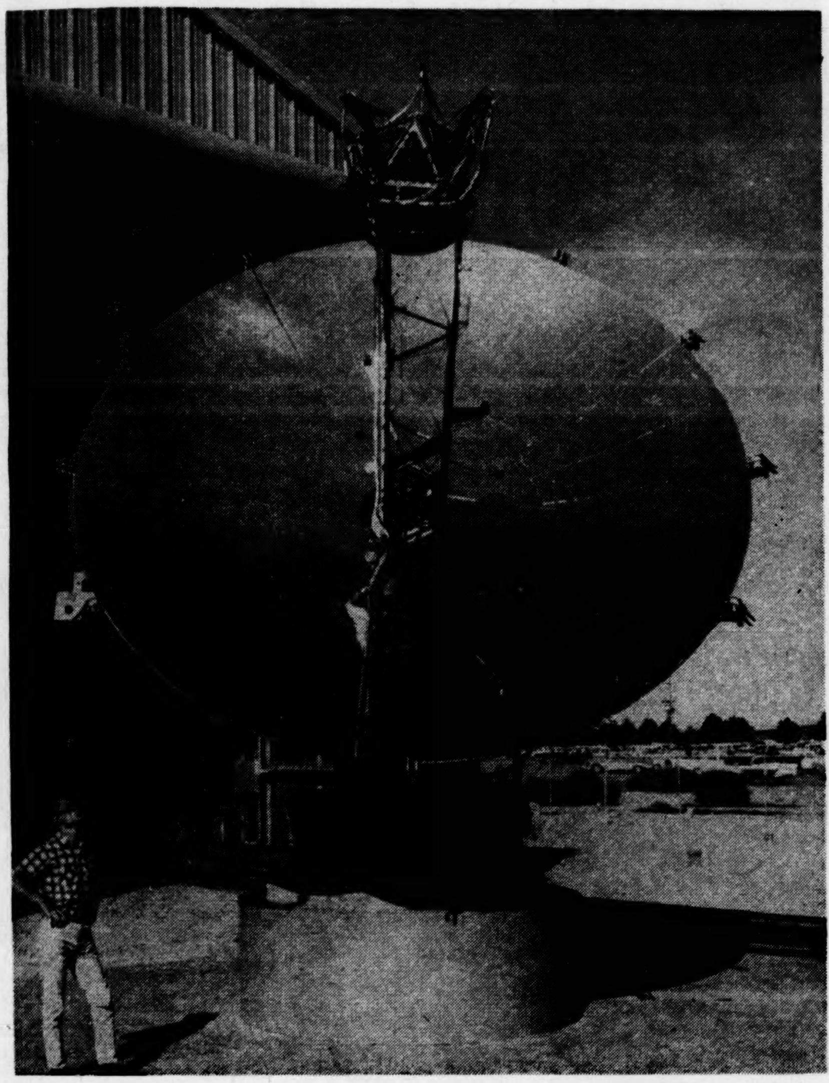
Interestingly, the Air Force work statement requests that environmental control and life support system be capable of meeting both the physiological and psychological needs of the three-man crew.

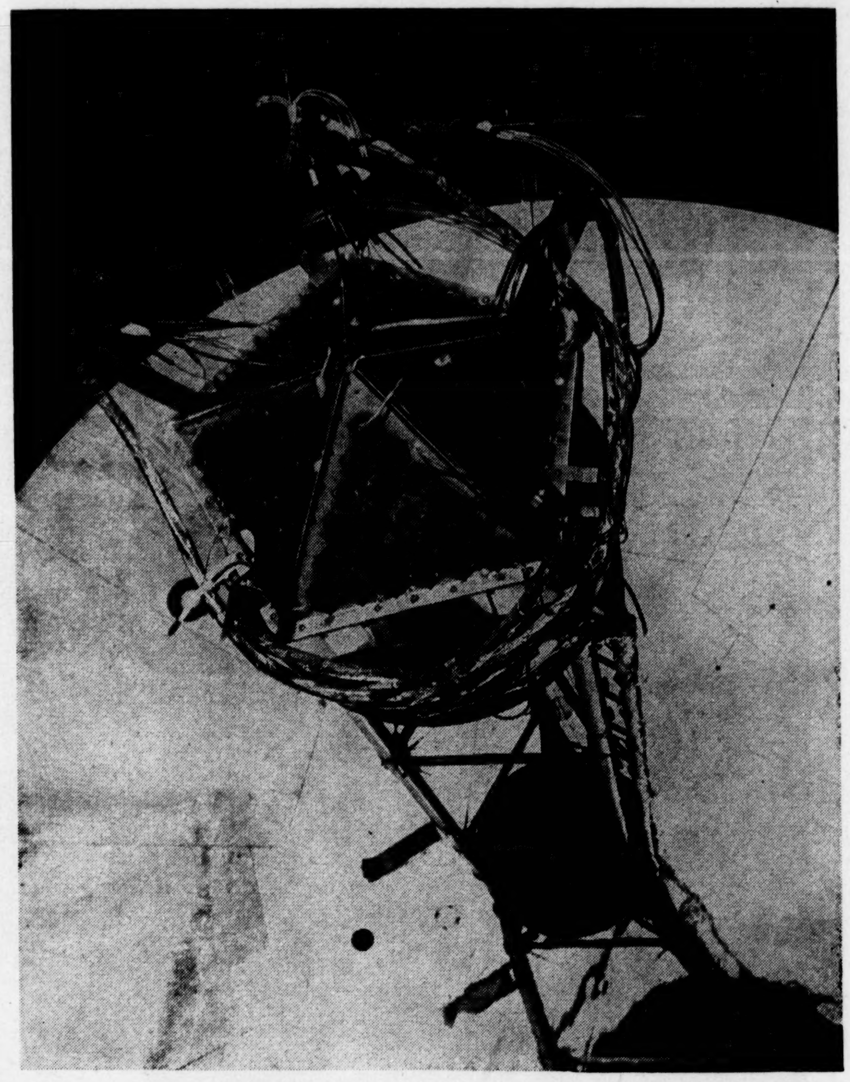
Vehicle Design

The vehicle is to be so designed that it may be controlled from the earth or the moon via direct earth-to-moon or lunar control links, respectively. Dual control technique would enable it to operate successfully without a crew before man steps on the moon. This is a growth capability that many companies that have studied roving vehicle concepts believe would be economically feasible and desirable. Radius of effective remote operation may be only two miles.

Checkout of vehicle subsystems and monitoring of its operation are to be able to be done remotely, too. Observations will be made of the lunar terrain by sensors, probably television, and perhaps infrared, and the data transmitted to lunar bases.

Heavy demands are being placed on the vehicle's communications system as Air Force is suggesting that the ve-





STEPS Generator Tested

Solar thermionic electrical power system (STEPS) directly converts solar energy to electrical energy. Shown above on radar antenna drive pedestal at Phoenix, Ariz., test facility, the system is expected to generate 300 watts in space environment. Orientation system locks on sun with maximum error of six minutes of arc. Collector, which unfurls from 12-ft.-dia. x 5-ft.-long cylinder to 15¾-ft.-dia. dish, focuses solar radiation on thermionic converters (right), heating cathodes and causing emission of electrons. General Electric's Missile and Space Vehicle Department, Philadelphia is developing STEPS for the Air Force Aeronautical Systems Division.

hicle's communications system be capable of maintaining contact with other lunar points both within and beyond the lunar-line-of-sight. Lunar line of sight is shorter than that of the earth because of the former's greater curvature (AW Oct. 9, p. 71) and the probable absence of an ionosphere which could reflect radio waves adds complexity to the communications problem.

Potential contractors will have extensive freedom in investigating and analyzing vehicle subsystems. Air Force is suggesting, however, a number of approaches which could be among those from which selections ultimately would be made. For example, radio, television, telephone, coherent light transmission and incoherent light transmission are among possible choices for local communications.

Alternate Choices

Other possible choices suggested for lunar roving vehicle subsystems are the following:

- **Power source**—Nuclear, fuel cell, solar, battery and chemical dynamic system.
- **Power transmission**—Electrical, mechanical, hydraulic, pneumatic, electromechanical.
- **Observation and navigation**—Radar, television, radio beacon, trail marking and visual.
- **Structure**—Double shell, laminated and monocoque.
- **Life support** and environmental control—Open systems, closed, semi-closed.
- **Manipulator**—Electro-hydraulic, mechanical, hydraulic, mechanical.
- **Vehicular controls and instrumentation**—Manual, mechanical, hydraulic, pneumatic, electro-mechanical.

The vehicle is expected to perform all its functions with a minimum of manual labor required.

The contractor must identify vehicle subsystems that will require an advance in the state of the art. He would also indicate magnitude of effort required in obtaining an integrated vehicle design including solutions to problems of power sources, seals, lubricants and air locks.

Compact Xenon Arc Lamp Is Developed

Cleveland, Ohio—Compact 5,000-w. xenon arc lamp capable of 275,000 lumens output, approximately three times the sun's intensity, has been developed by General Electric's Large Lamp Department to simulate solar radiation for missile and space vehicle ground tests.

GE engineers maintain that aiming banks of the lamps at parabolic mirrors to create a parallel light beam, produces a flux density of 130 w./sq. ft. simulating the effect of sunlight on vehicles in near space.

These tests could help determine thermal balance of spacecraft and test performance of devices designed for response to solar radiation, according to GE.

The xenon arc lamp is highly stable and free of noise, smoke and fumes during operation, the company adds. The lamp is a direct-current light source housed in an ellipsoid quartz bulb. Over-all length is slightly more than 19 in., but the bulb itself is about 3½ in. in diameter and 4¼ in. long.

The bulb houses two tungsten electrodes with an 8 mm. arc gap operating in a high-pressure xenon atmosphere. Although lamp life ratings have not been established, GE has set an objective of 1,000 hr. average life under normal operating conditions for the 5,000-w. lamp, which will be marketed soon, and a similar 2,000 w. lamp, already on the market.

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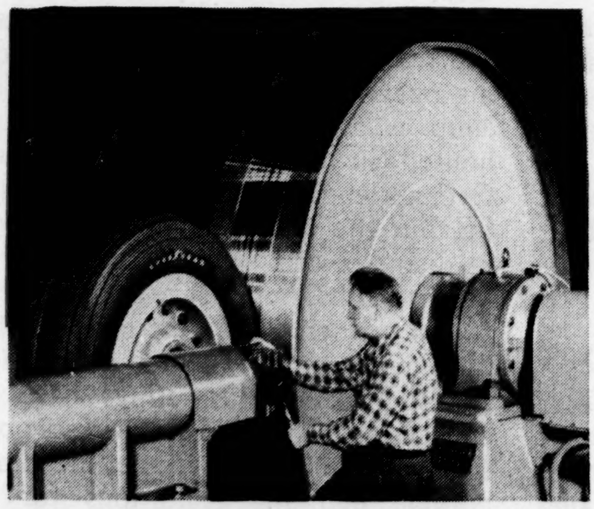
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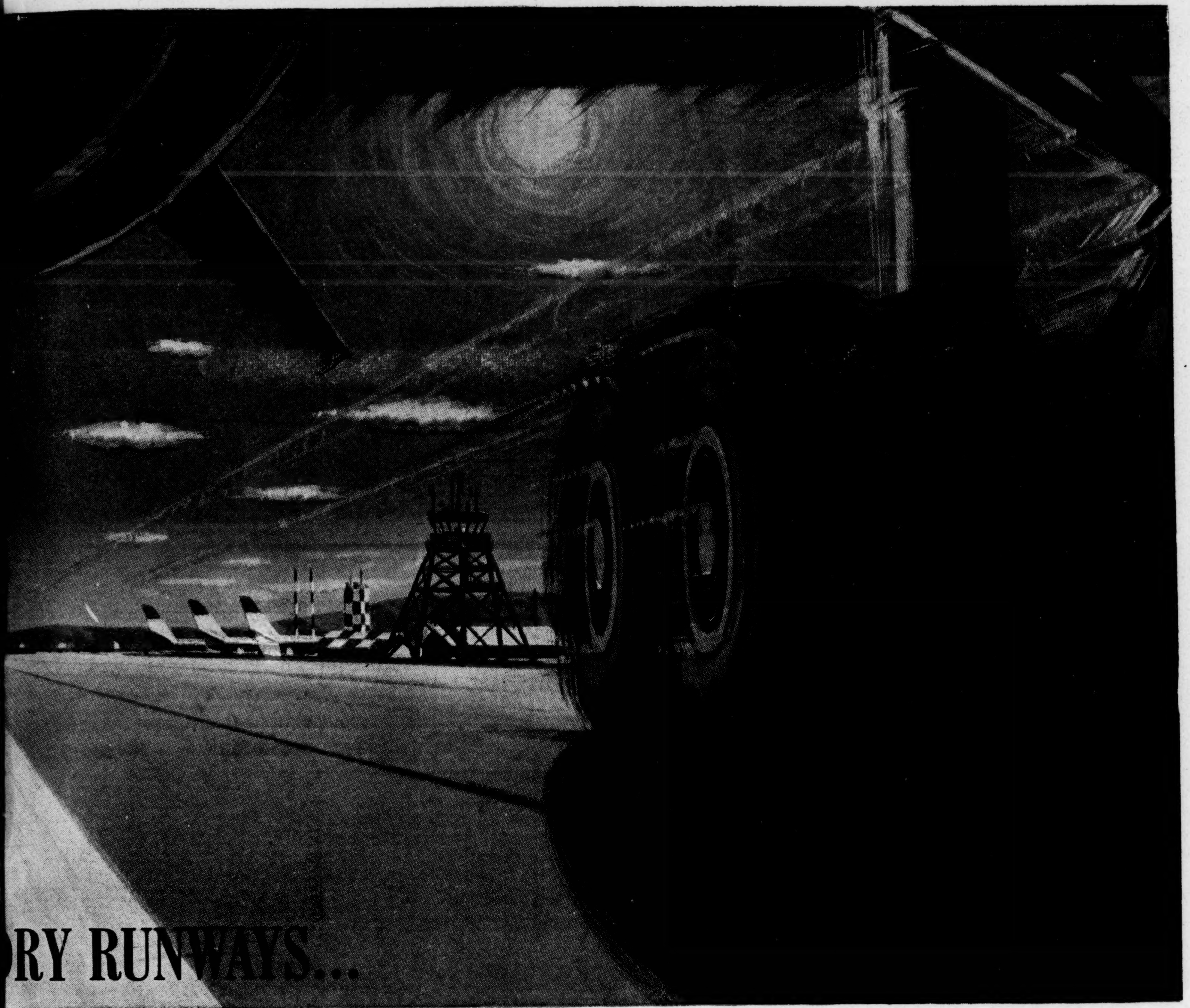

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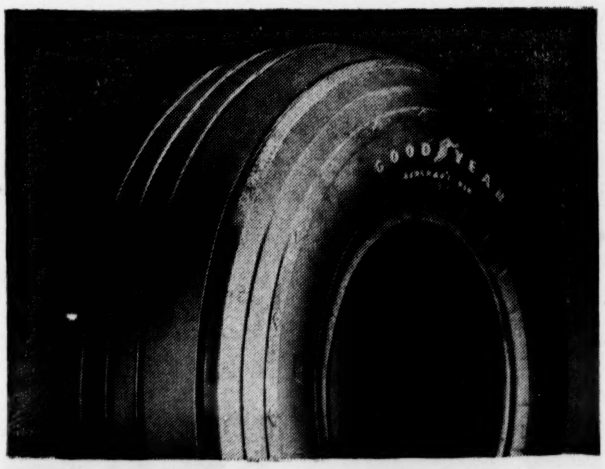

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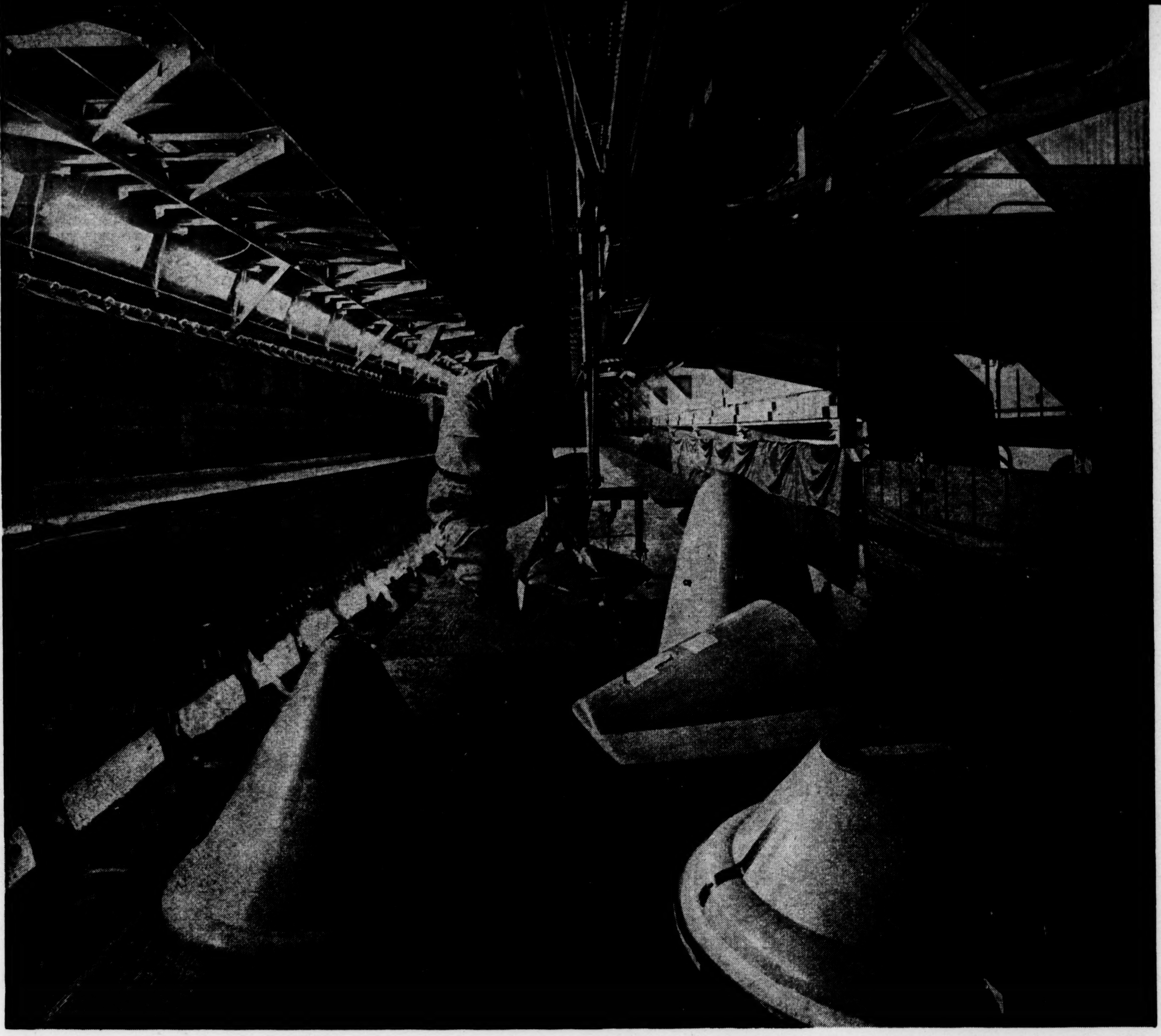
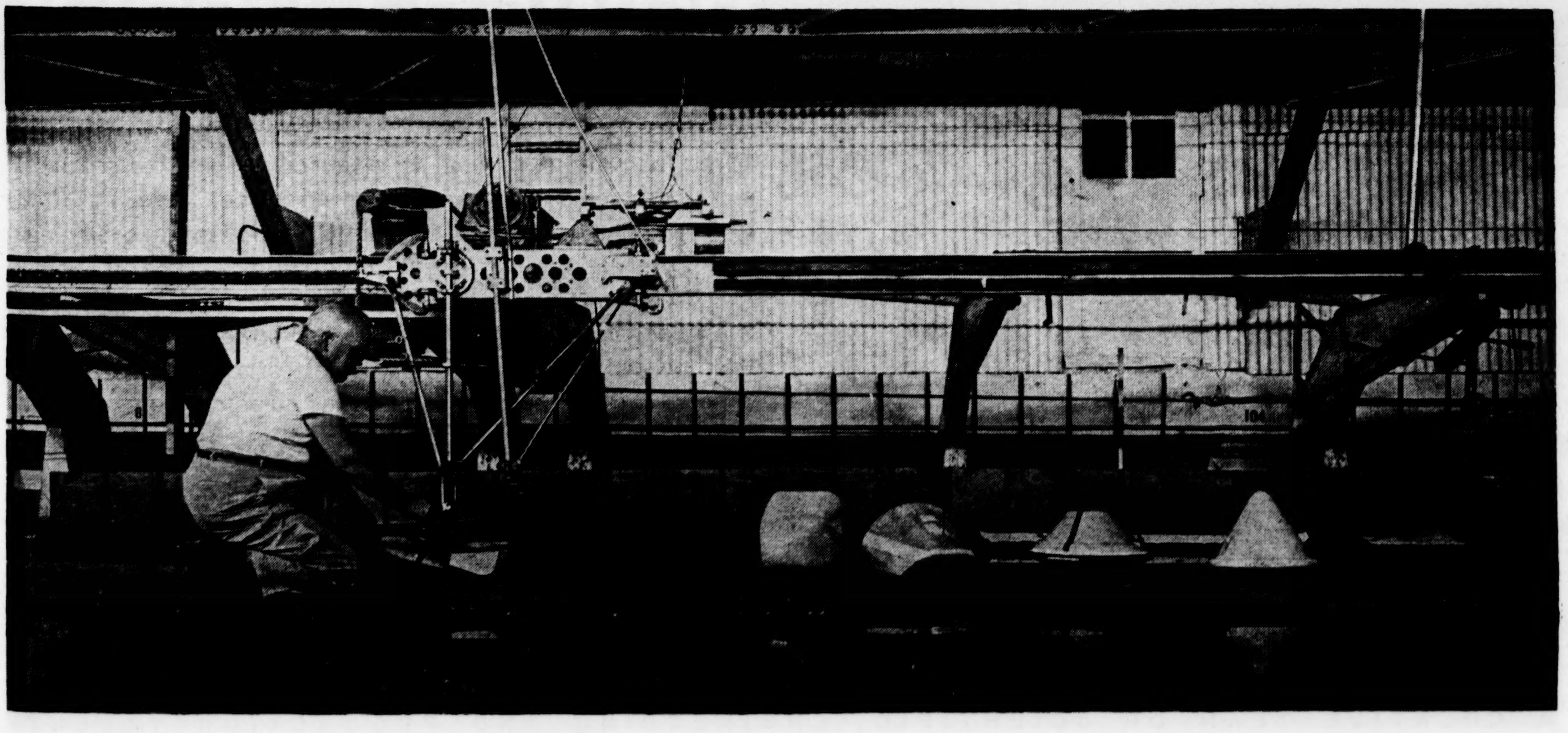
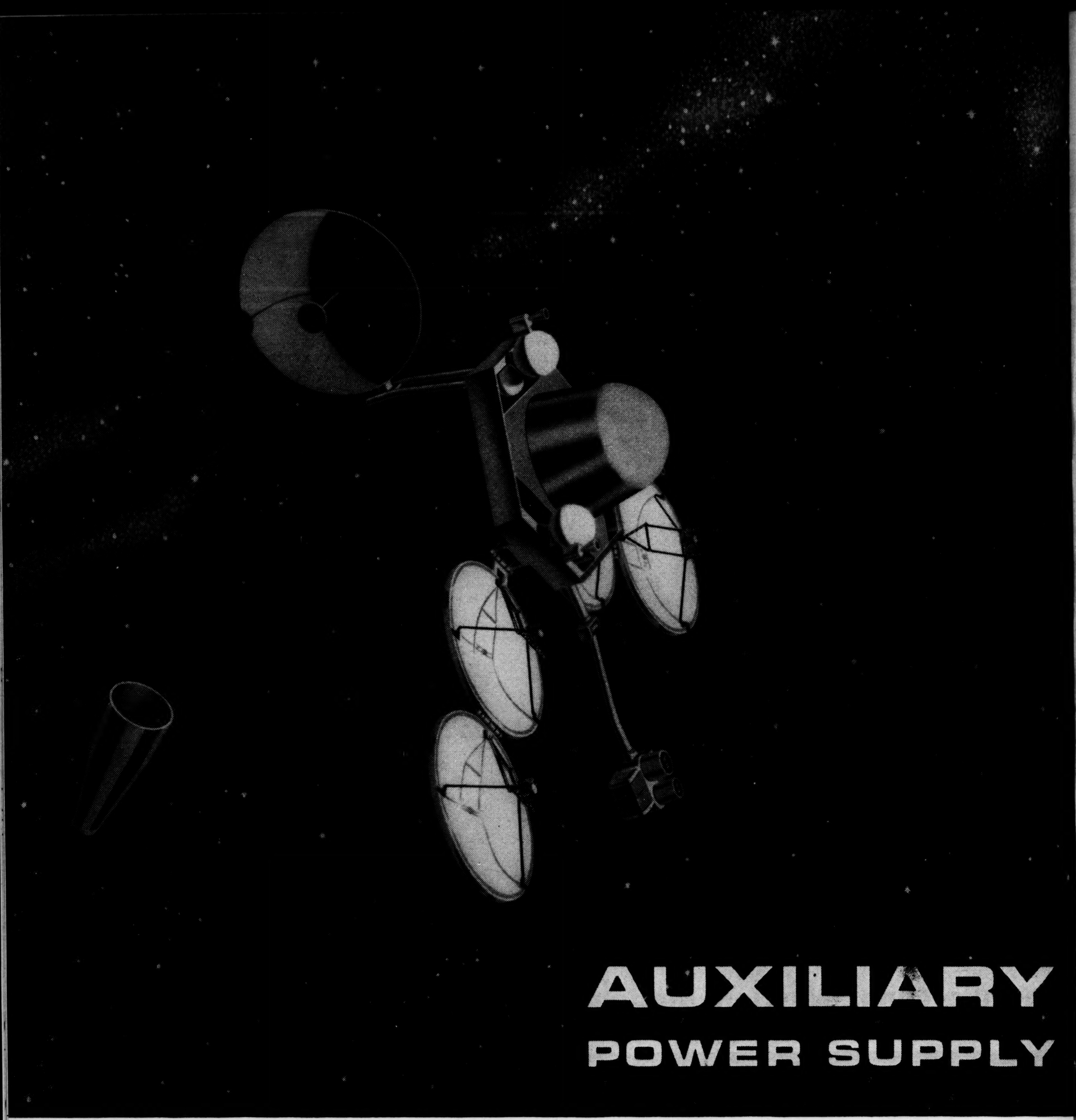


NASA Tests Landing Traits Of Various Lunar Mission Models

Various configurations of lunar mission models are tested at National Aeronautics and Space Administration's Langley Research Center, Va., to determine their earth landing characteristics. Some tests are conducted by landing the models on the wooden platform; others by landing the models on water. The models are catapulted by an overhead device. Technician is preparing lenticular-shaped model with stub wings for testing.





Direct conversion of heat to electricity offers the solution to the problems of auxiliary power in space.

New techniques of space charge neutralization are being developed at Ford Instrument Company under U.S. Air Force, U.S. Navy and company sponsored studies. This work offers the opportunity to obtain significant power densities with wide spaced plasma power diodes at cathode temperatures around 1200°C. Application studies currently being undertaken involve chemical, solar and nuclear heat sources. 1.6

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Ford Instrument guidance and control components participated in these missile and space "firsts": First Free-World man-into-space vehicle (MERCURY-REDSTONE) • First operational ballistic missile (REDSTONE) • First successful launching of a Free-World satellite • First successfully recovered nose cone • First successful Free-World space probe.

A CREATIVE TEAM OF SCIENTIFIC, ENGINEERING AND PRODUCTION TALENT

Oscar 1 Amateur Radio Satellite Launched by USAF Discoverer 36

By Russell Hawkes

Oscar 1 amateur radio satellite was successfully launched into a polar orbit last week as a piggyback spacecraft aboard USAF Discoverer 36.

Beacon in the 10-lb. satellite began transmitting 28 min. after launch indicating successful separation from the Agena carrier rocket. The signal was first acquired by a U. S. ham station in Marie Byrd land, Antarctica and the information was immediately relayed to the Oscar control center at Sunnyvale, Calif. by amateur single side band radio.

Oscar 1 (AW Feb. 13, p. 77) is to transmit a beacon identification signal for three weeks on a carrier frequency of 145.0 mc. in the amateur radio two-meter band.

It is intended to give amateur radio operators all over the world experience to prepare them to use more ambitious active amateur communications satellites proposed by the amateur Project Oscar Assn.

Association officials are confident that success of the first satellite will generate strong support in government and industry for the later proposals. The project already has the expressed backing of the U. S. Information Agency.

No money is being sought for the project. The association is composed entirely of radio amateurs with professional experience in U. S. space programs and has strenuously resisted anything which might compromise the amateur nature of the project. Equipment has been assembled from components donated to the project without charge by various companies and the people who have designed and manufactured it worked without pay.

There are three Oscar 1 satellites on hand at Vandenberg AFB. The one launched was selected shortly before launch time. One effect of reliance on donated parts has been to make it impossible to make the three satellites identical. Donors of some of the more expensive components could not afford to offer a complete set of three, and differences between those offered by different manufacturers forced some variety in circuitry.

The American Radio Relay League, governing body of U. S. amateur radio, has used its publications and other channels to disseminate information about Oscar to amateur radio operators in the U. S. and other countries.

The Project Oscar Assn. is currently studying 26 technical approaches to the design of more advanced amateur communications satellites which can be built if expected non-financial government support materializes. One of these approaches includes a simple, low-cost attitude stabilization scheme.

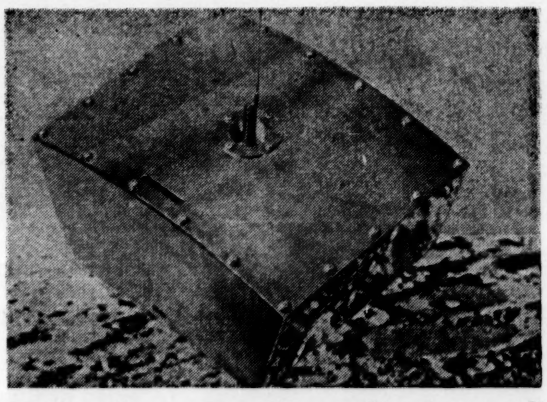
Oscar 1 weighs 10 lb. and is encased in a magnesium housing curved to fit under the outer skin near the aft end of the Agena B spacecraft. When the Agena has separated from the aerodynamic skin which covers its aft end at launch, the ballast compartment in which Oscar 1 is placed is uncovered, making ejection possible when Agena has achieved orbit. Outer surface of Oscar 1 is plated with 0.1 mil of gold.

A quarter-wave monopole antenna, folded at launch, springs erect in the center of its ground plane on one side of the satellite when it has been separated from its Agena carrier rocket. The housing is about 10 in. x 12 in. x 5 in. and contains a 100-milliwatt beacon transmitter, keyer and nickel-cadmium or silver-cell batteries encapsulated in foamed epoxy.

The all-solid-state beacon will transmit the Morse Code identification signal "hi." The orbital lifetime of the satellite is expected to be about 30 days but the beacon will transmit only for three weeks, plus or minus three days.

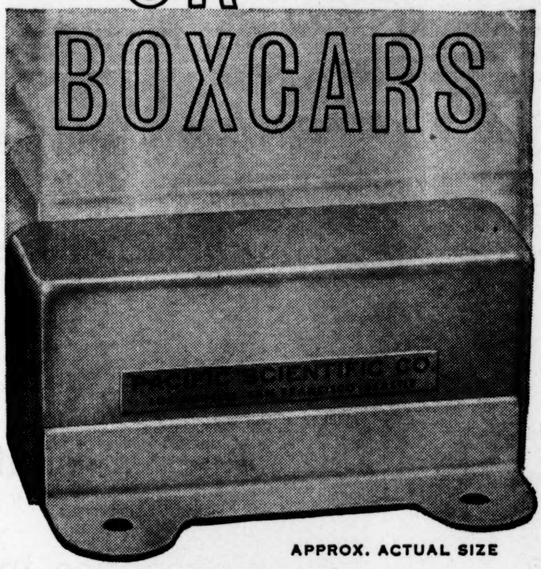
The Project Oscar Assn. has supplied amateur radio operators with four tracking techniques and reporting formats.

However, operators have been urged to develop their own techniques if their experience suggests better ones and to report these to the association. Recommended procedures range from simple reports of acquisition and fadeout times and signal strength to three-dimensional direction finder techniques and Doppler shift plotting for the better equipped and more experienced amateurs. The rate at which the beacon keyer sends identification signals is sensitive to temperature in the satellite and all operators have been advised to measure and report the time required to send 10 complete identification signals. This will help determine the validity of acquisition reports.



OSCAR 1 amateur radio satellite is a small VHF transmitter in a curved housing to fit into aft end of Agena B space vehicle.

FOR "BIRDS" OR BOXCARS



APPROX. ACTUAL SIZE

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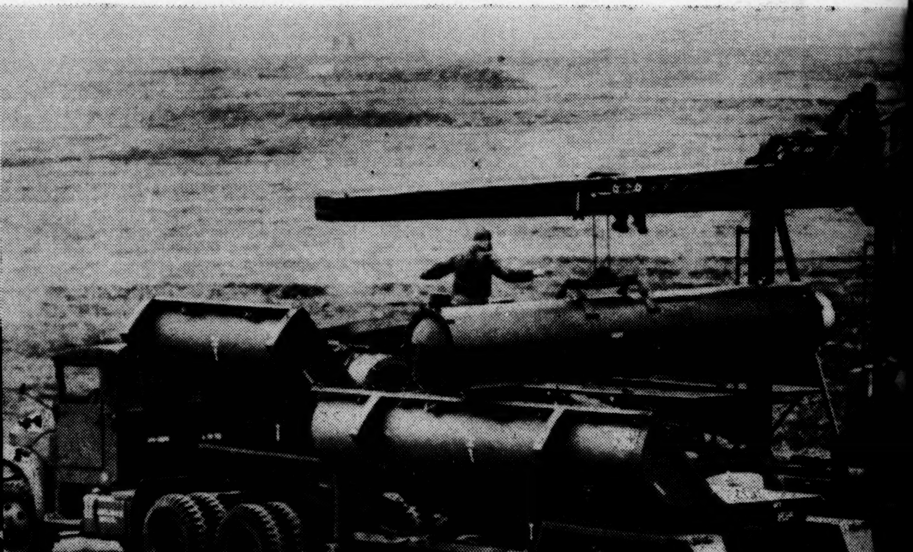
Half-mule, half-bird The U.S. Army's Sergeant, now in production, is artillery, and it can traverse terrain where caissons used to go rolling along. And for long, fast hops, the Sergeant can readily be airlifted. The prime contractor, Sperry Utah, wisely selected new, light gages of USS "T-1" Constructional Alloy Steel with 100,000 psi yield strength for the ground support special purpose equipment. USS "T-1" Constructional Alloy Steel is three times stronger than structural carbon steel, thus fabricated components can be made thinner and lighter with no sacrifice in strength. The entire launcher is air-transportable because it weighs only 16,000 pounds—7,000 pounds less than if built with structural

"Keeps America's strength high."

Wide use of USS "T-1" Steel makes the transporter-erector-launcher 7,000 pounds lighter and completely air-transportable.



Frame components of special purpose container transport trailers are "T-1" Steel; launcher boom is also "T-1" Steel, for maximum strength and minimum weight.

All major structural components were designed at an allowable working stress of 66,700 psi.

carbon steel. When your missile support system goes on the drawing board, you can obtain applications and development assistance by consulting the one producer of all basic materials for support hardware and facilities. Whether it's carbon steel or special constructional alloy steels, electrical cable or wire rope... consult

United States Steel

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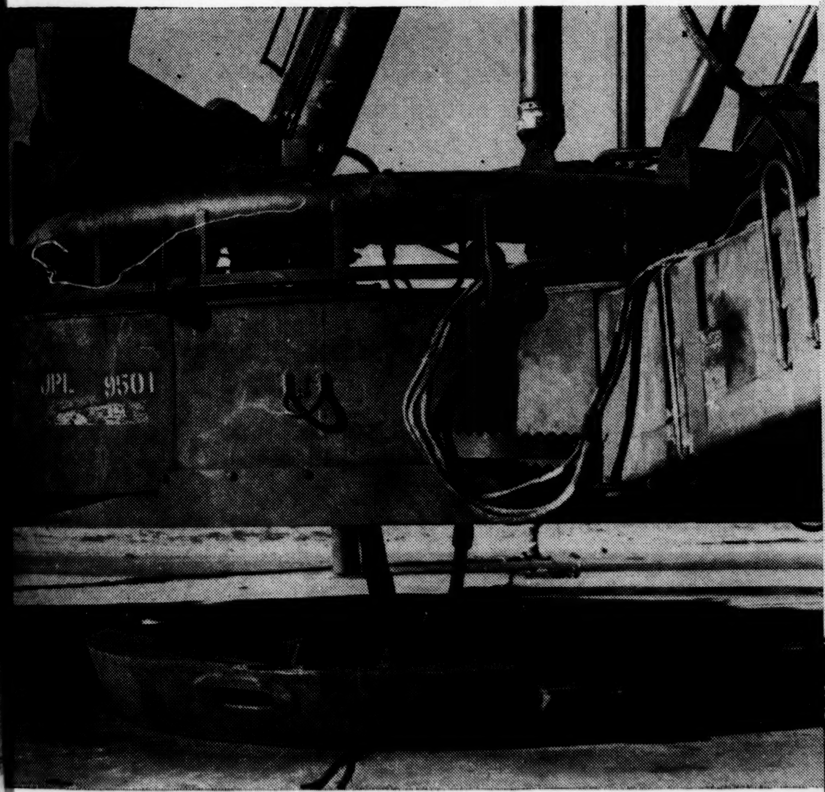
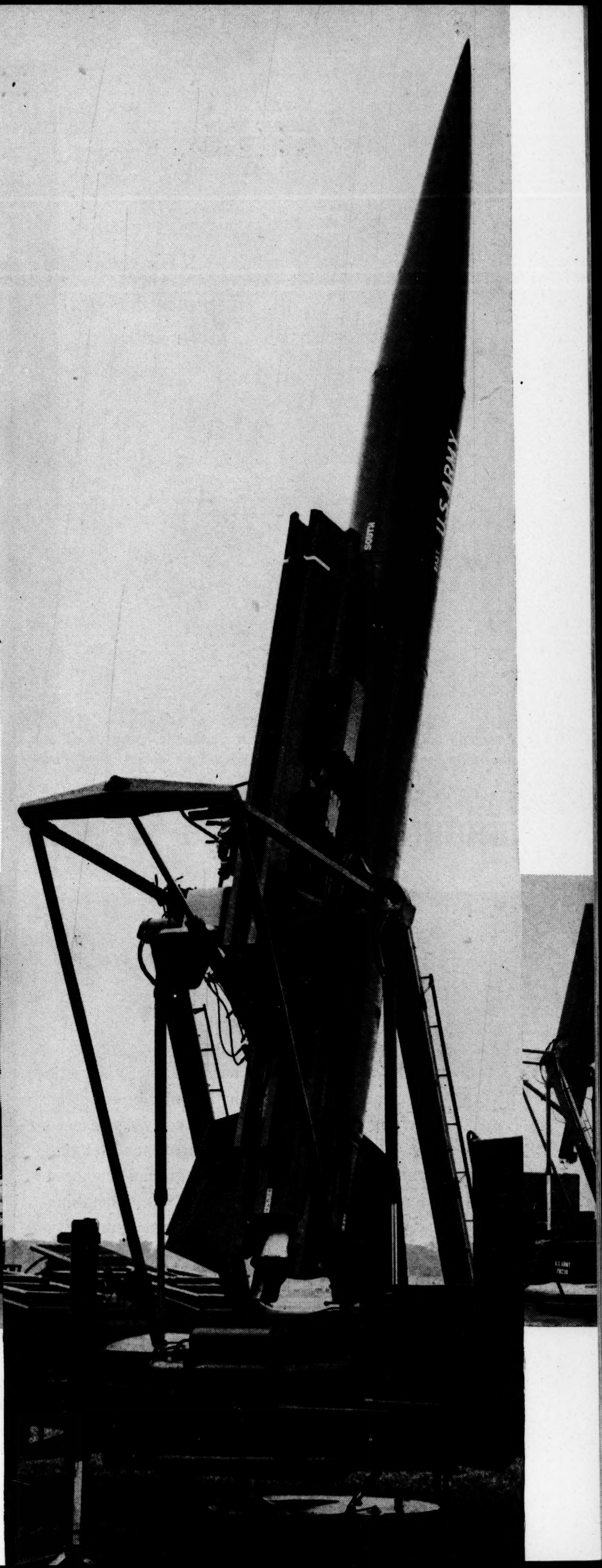


6½″ diameter welded USS "T-1" Steel tubing forms the torus ring of the launching superstructure.



USS "T-1" Steel outrigger legs stabilize the unit in firing position. Also made of "T-1" Steel are the U-frame, extension arms, top and rear tension members and back beam.

To thread a needle in unmanned flight...

required Motorola systems ingenuity

NAVIGATION with "needle's eye" precision is achieved by Motorola RDI. Synergistic combinations of Radio, Doppler, and Inertial sensory data into one integrated system exceed the sum of the capabilities of each. Ranging hundreds of miles from their ground-anchored reference, these R+D, R+I and R+D+I combinations provide targeting accuracy...immunity to interference...resistance to detection. Unique combinations of these techniques have been proven in applications requiring real-time, position-fixing and space vehicle-guidance. These Motorola systems originally were designed for missile guidance and surveillance drone navigation...they now provide reliable solutions to a broad range of problems requiring continuous, current, and extremely accurate control data never before attained in a dynamic environment. Sensory synergism is another demonstration of Motorola's systems ingenuity. Classified details of these programs are available to those with an established need to know.

Military Electronics Division MOTOROLA

All qualified applicants will receive consideration for employment without regard for race, creed, color, or national origin

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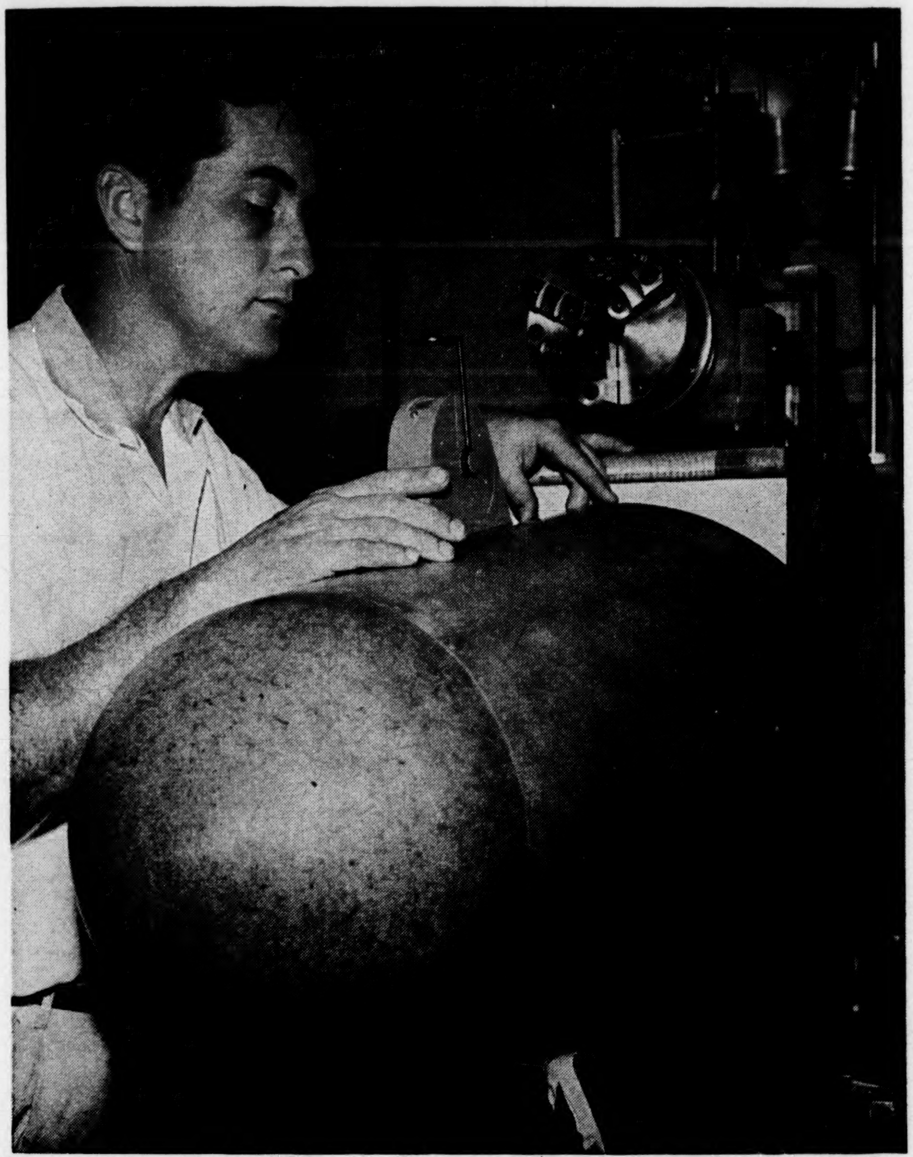
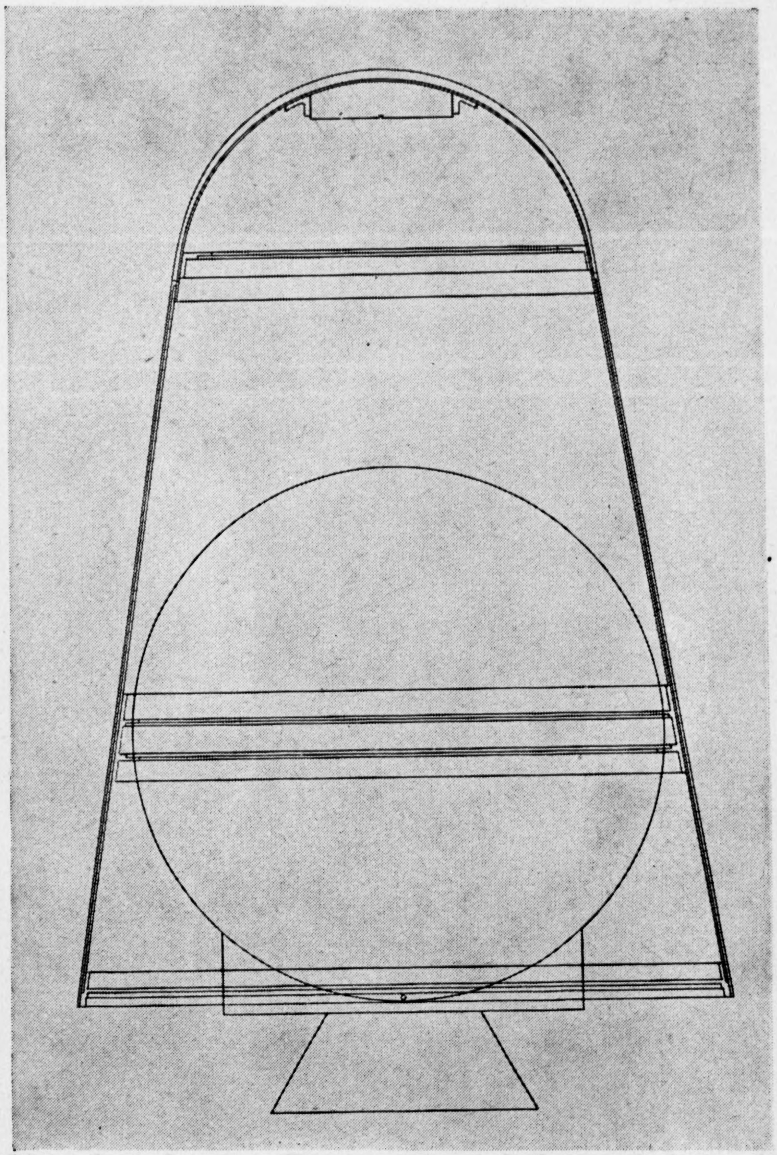
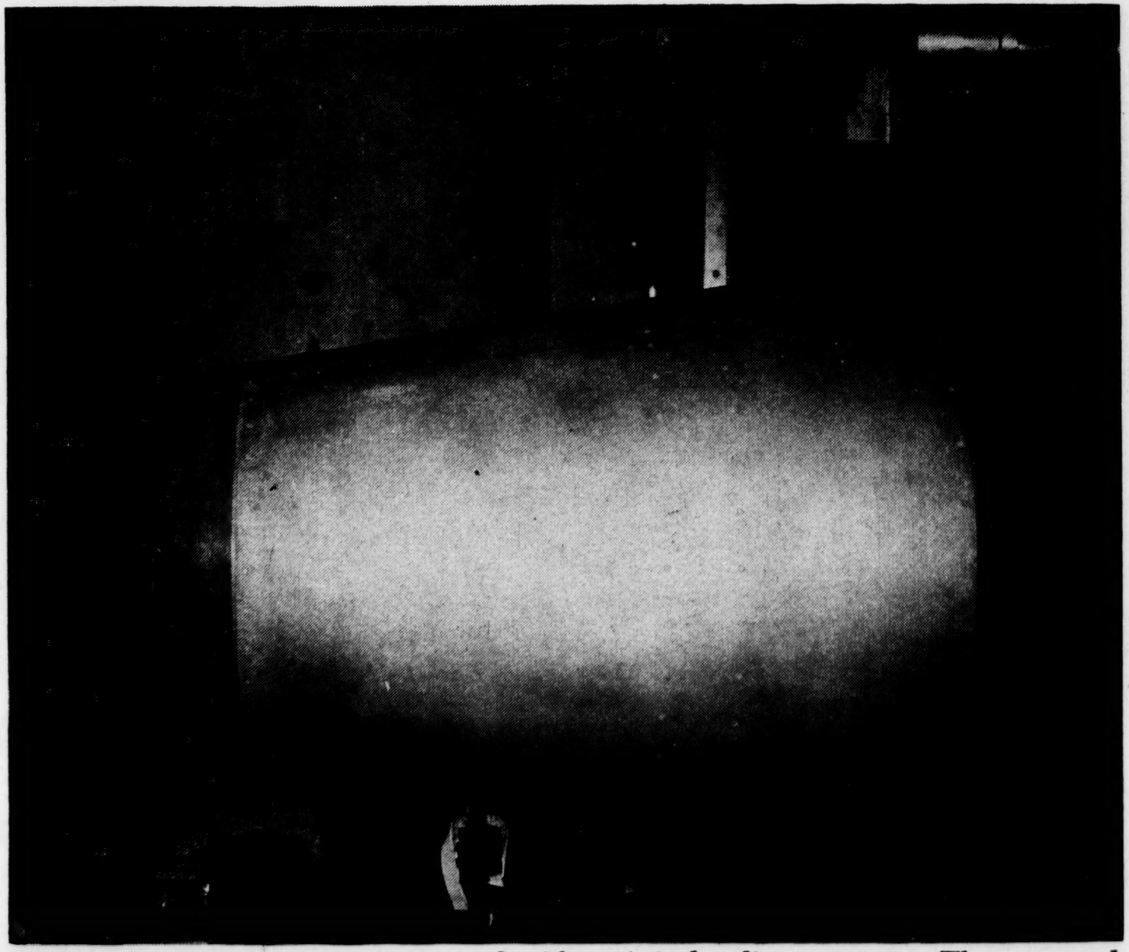
SCOTTSDALE, Arizona, 8201 East McDowell Road
RIVERSIDE, California, 8330 Indiana Avenue





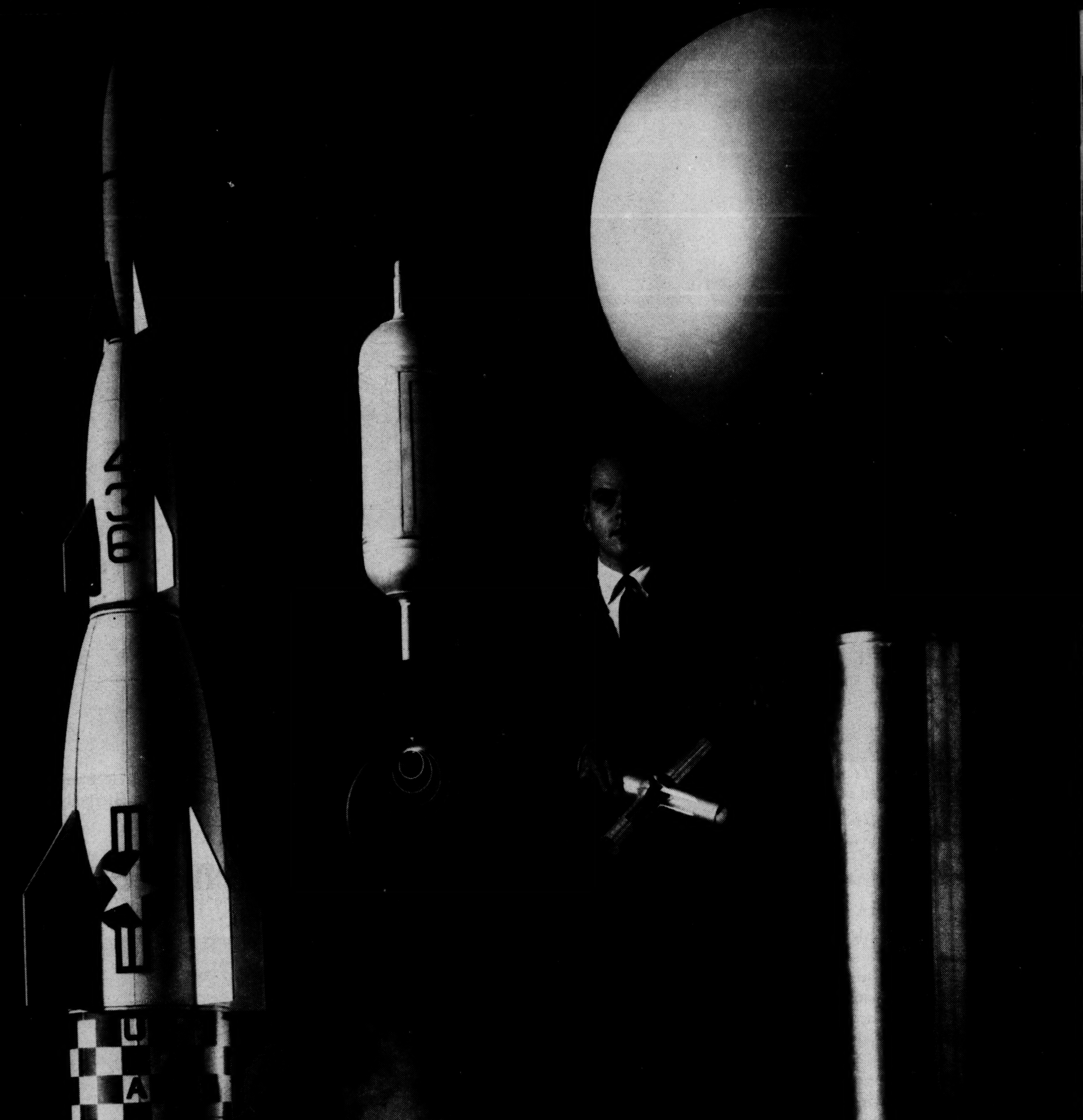
Line drawing of the 27-in. Trailblazer nose cone shows location of the 15-in. spherical motor. Fixture at top is ballast, and electronic instrument package is installed in the forward bulkhead. At left, a General Electric technician inspects the surface of the payload afterbody.

Trailblazer 2 Series to Study Re-entry Phenomena



Trailblazer's 45-lb. nose cone is covered with a six-inch-radius nose cap. The cone and ablative cap were built by General Electric's Missile and Space Vehicle Department.

Trailblazer 2 rocket series, designed to study re-entry physics phenomena, is under way at Wallops Island, Va., as part of the Project Defender experiments sponsored by the National Aeronautics and Space Administration, Lincoln Laboratory of the Massachusetts Institute of Technology and the Advanced Research Projects Agency. Fourth stage structure was built by General Electric Missile and Space Vehicle Department, which also designed and installed the instrumentation. The stage weighs 45 lb., and is 27 in. long. Weight reduction was obtained by using magnesium and thorium for the inner structure. The four-stage launch vehicle, engineered and fabricated by Atlantic Research Corp. Space Vehicle Group (AW Jan. 16, p. 102), consists of a Thiokol Castor booster stage, which has two Thiokol Recruit assist rockets; Grand Central Rocket TX-77, Lance; third-stage Hercules-Allegany Ballistics Laboratory 248 Altair, and fourth-stage spherical, built by NASA's Langley Research Center, called Cygnus. First two stages are designed to lift the vehicle to an altitude of one million feet. The vehicle then noses over, and the last two stages drive the nose cone to a velocity of more than 20,000 fps. Spectrographic and meteor cameras obtain velocity data.



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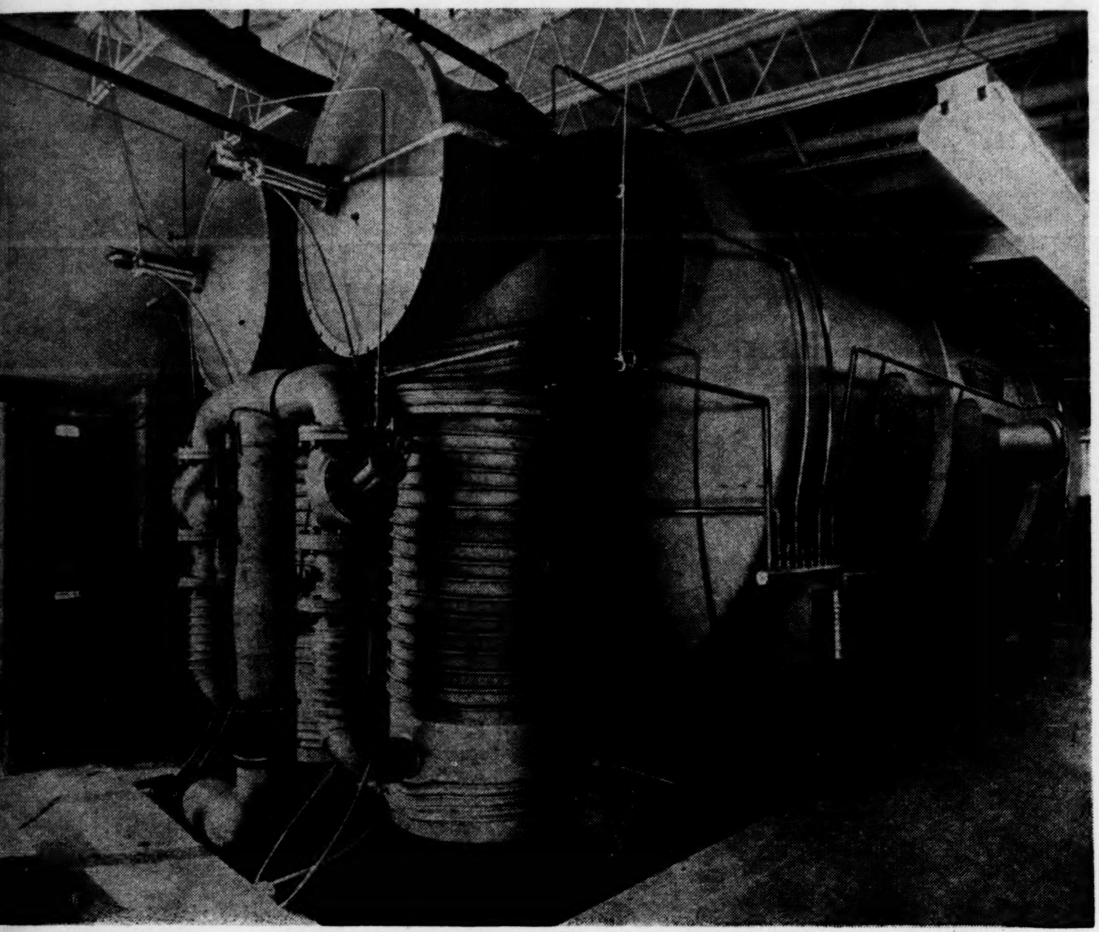


Orbiting Observatory Test Chamber Built

Orbiting solar observatory, being developed by Ball Brothers Research Corp., Boulder, Colo., or the National Aeronautics and Space Administration, will be tested in this 10-ft.-dia., 5-ft.-long space simulator. The chamber, built by High Vacuum Equipment Corp., Hingam, Mass., can be evacuated to 2 x 10^{-8} mm. without cryogenic pumping. Simulated altiudes between 200 and 300 mi. can be achieved.

Space Laboratory to Test Re-entry

Simulated re-entry conditions for a wide variety of space flight profiles will be incorporated in a new space vehicle esearch laboratory now under construcion at Avco Corp.'s Research and Advanced Development Division, Wilmington, Mass.

The 79,000-sq. ft. structure, will be completed next spring at an estimated cost of $1 million.

It will be combined with an existing building that presently houses the division's high-temperature, high-velocity esearch facilities.

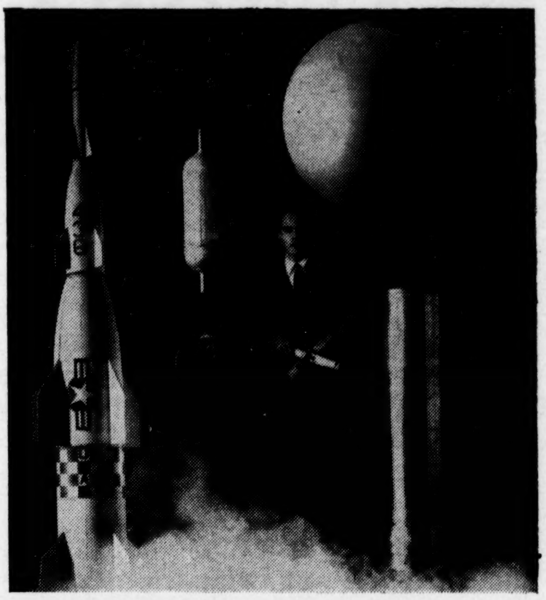
Laboratory Equipment

The new laboratory will contain the ollowing equipment:

- **10-megawatt arc shroud** for high temperature materials research, simulating the enthalpies of ICBM re-entry vehicle and orbital velocities.
- **Shock tunnel** with a 12-ft. dia. working section. Avco says this facility is twice the size of any similar existing unit and will be able to accommodate nearly full-scale ICBM nose cones or space vehicles of equivalent size. Using -in. dia. shock tube sections stressed to 60,000 psi., the new shock tunnel will be capable of velocities of up to Mach 30 and will provide 45 channels f data.
- **6.5-in. dia. shock tube,** for study of the radiative heat transfer loads on reentering space vehicles. Using an electrically-created driving force, this facility will simulate enthalpies equivalent to 36,000 fps.
- **Magnetohydrodynamic accelerator** shock tube, to accelerate ionized gas flows up to 60,000 fps. Avco says this velocity is comparable to that of a vehicle returning from a Mars or Venus probe.
- **Molecular-beam shock tunnel** to study surface interactions of elementary particles with space vehicles at extreme altitudes.

The new building also will house some test equipment already in operation at Avco, including an orbital vehicle re-entry simulator (OVERS), a 2-megawatt arc tunnel capable of Mach 2.5 gas flows with durations of up to 10 min., and a 10-megawatt arc tunnel, producing velocities of Mach 5 in a 1-ft. dia. working section.

Avco says that a 33,000 cu. ft. capacity central vacuum pumping system will allow almost continuous operation of the large arc tunnel and will accommodate planned future installation of an ultra-high vacuum laboratory, a cryogenic laboratory, a cryogenic low-density wind tunnel and a space chamber.



WELDABLE CRYOGENIC ALUMINUM ALLOY THAT'S STRONGER, THRIFTIER THAN STEEL

At −423°F (boiling point of liquid hydrogen), Alcoa® Aluminum Alloy 2219 has an ultimate tensile strength of 92,000 psi. Even at elevated temperatures, 2219 alloy's mechanical properties are superior to those of any other commercially available aluminum alloy.

Alloy 2219 has other likable attributes. For one, it costs about one-quarter as much as stainless steels. For another, it's easy to form and is as weldable as aluminum alloy 6061. Also, it is compatible with presently used fuels and oxidizers and has good ballistic characteristics.

ALL ABOUT CRYOGENICS — Alcoa Research and Development Laboratories possess considerable information on the high- and low-temperature properties of aluminum alloys. If alloy selection or the fabrication of cryogenic aluminum presents difficulties, get in touch with Alcoa. Odds are overwhelming that out of the minds of the men who staff these laboratories—or from the volumes of aluminum data at their disposal—there will come the answer.

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AiResearch's 331 Engine Tested on Lark

By William S. Reed

Phoenix, Ariz.—AiResearch Manufacturing Division of the Garrett Corp. is seeking to expand into the light helicopter powerplant market with the Model 331-7 light turbine engine which was flight-tested recently in a Republic-built Lark, a version of the Alouette helicopter.

AiResearch's light turboshaft engine, while weighing approximately the same as the French-built Artouste,—200 lb.—produces 500 eshp. at a specific fuel consumption of 0.619 lb./shp./hr.

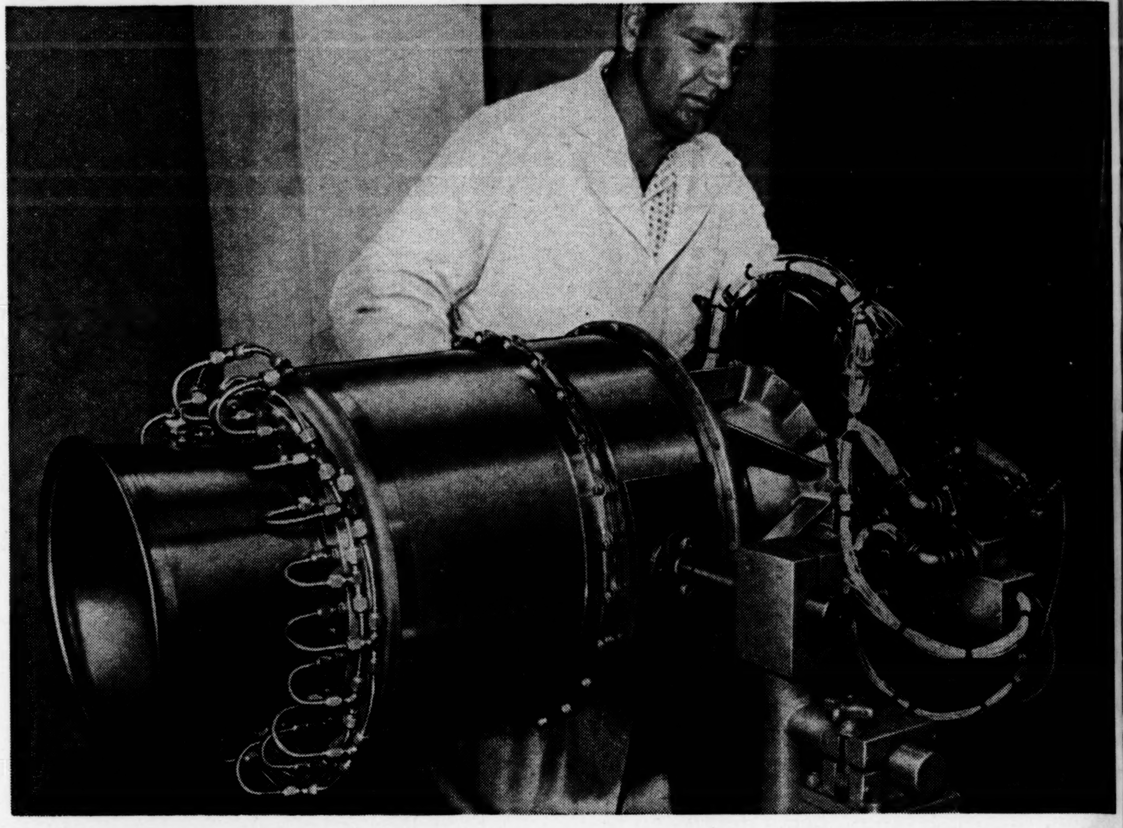
AiResearch recently teamed with Republic Aviation in a flight test program aimed at enhancing the Lark's position in the Navy's Assault Support Helicopter (ASH) competition by equipping it with a U. S.-made engine (AW Nov. 20, p. 23).

Market for light turbine engines looms potentially large, AiResearch contends, because of the off-the-shelf nature of the Navy Assault Support Helicopter specifications. The four-five passenger capacity of the helicopter dictates an engine in the 500-eshp. class and this lends itself to commercial applications such as air taxi, construction, search and rescue. Army's light helicopter market has been estimated as being in excess of 4,000 in the next five years (AW Sept. 5, 1960, p. 30), making entrance into powerplants for this type machine a potentially lucrative field. AiResearch is entered in the competition for an alternate engine for the LOH program (AW Nov. 27, p. 24).

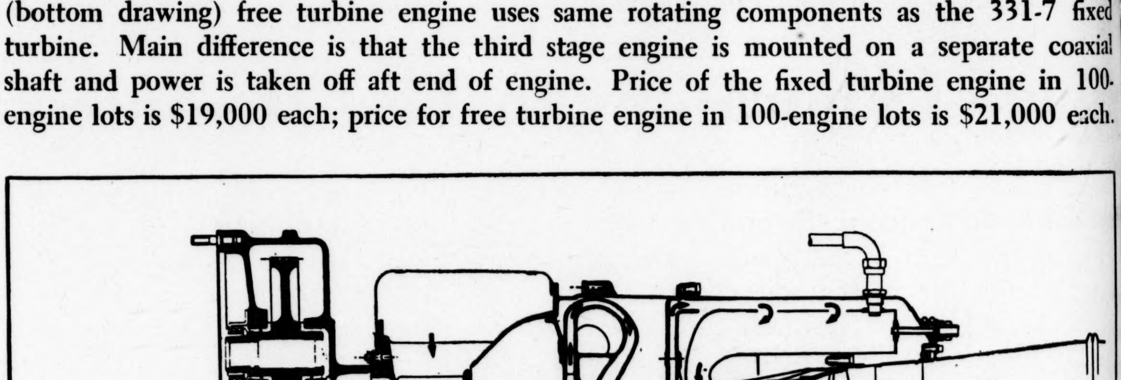
AiResearch has built more than 9,000 light turbine engines ranging in size from 35 to 850 eshp., but applications have been confined to ground and auxiliary power units and jet engine starters. None has been applied as primary propulsion unit for aircraft.

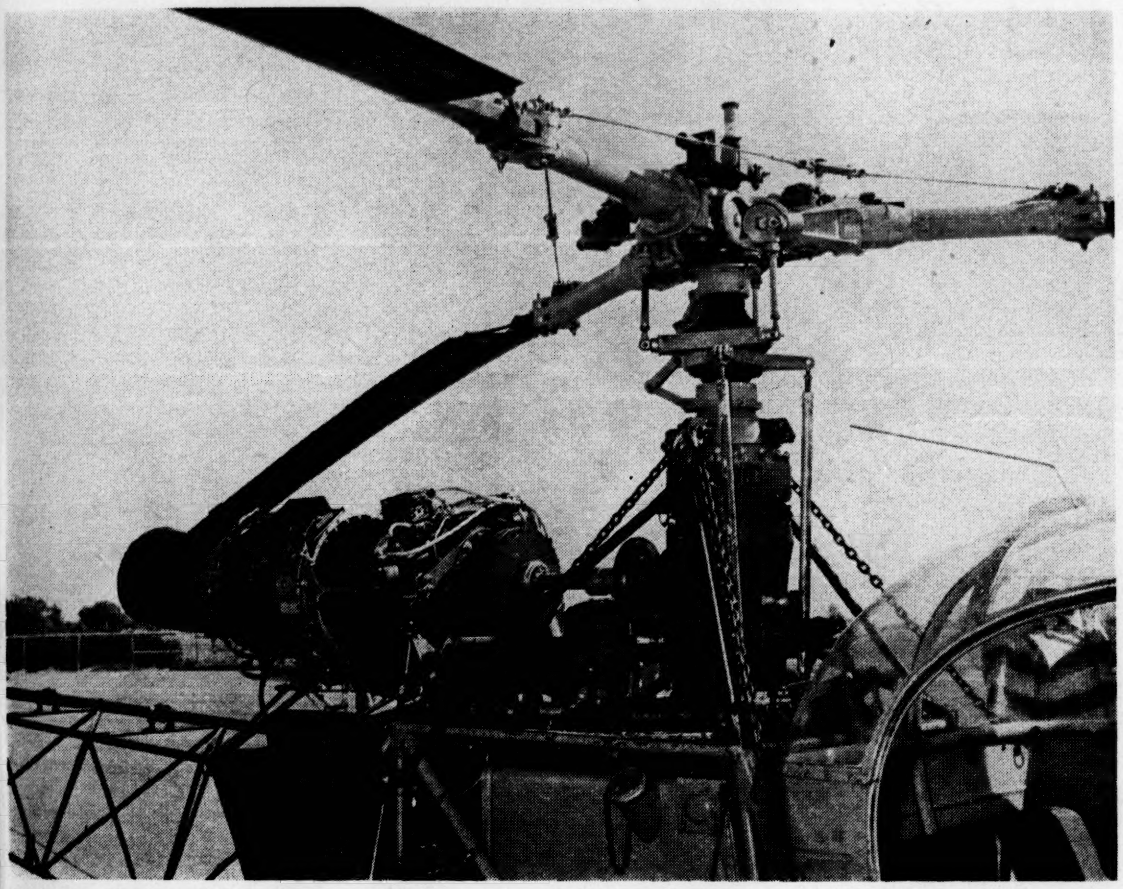
The joint Republic-AiResearch flight test program involved 6 hr. of flight and 3.5 hr. of static ground running. Highlights of the test program revealed that:

- **Fuel consumption** averaged 25 gph. during flights which were conducted mostly under high load conditions. Average fuel consumption for the Artouste engine under similar conditions is roughly 45 gph. Phoenix elevation of 1,125 ft. and high ambient temperatures contributed to demands made on the engine.
- **Flight to corrected altitude** of 11,000 ft. was made with a gross weight of 3,348 lb. Altitude was not limited by engine capability but by convenience. Service ceiling of the Republic Lark is 10,500 ft. at 3,300 lb. gross weight.



AIRESEARCH MODEL 331 turbine engine develops 500 eshp., weighs 200 lb. (above). Model 331-7 (first drawing below) fixed turbine engine features two centrifugal compressors in tandem and a three stage axial turbine. Engine turns at 39,000 rpm. Model 331-50 (bottom drawing) free turbine engine uses same rotating components as the 331-7 fixed turbine. Main difference is that the third stage engine is mounted on a separate coaxial shaft and power is taken off aft end of engine. Price of the fixed turbine engine in 100-engine lots is $19,000 each; price for free turbine engine in 100-engine lots is $21,000 each.





AIRESEARCH TURBINE ENGINE was mounted in the Republic Lark helicopter using the same mounting pads as the French-built Artouste engine. Picture was taken during static runs in Phoenix, Ariz., hence the chains. Model 331 engine powered the Lark to 11,000 ft. at maximum gross weight. Normal service ceiling is 10,500 ft.

• **Noise level** of the helicopter/engine combination was considerably reduced, compared with the Lark/Artouste measuring 84 db. 100 ft. from the inlet.

The AiResearch Model 331 engine is being developed in two models—fixed shaft and free turbine. Rotating parts of both models are interchangeable.

Fixed-Shaft Engine

The fixed shaft engine has two tandem centrifugal compressors, an annular combustion chamber and a three-stage axial turbine. Compressor pressure ratio at maximum power is 6.5/1. Each of the compressor impellers and turbine wheels is of single piece construction. The impellers are machined out of a solid piece and the turbine wheels are cast of Inconel in one piece. The only machining done on the turbine wheels is finishing the hub and balancing the completed unit. Cost of the one-piece turbine wheels is about one-fourth that of built-up assemblies, AiResearch maintains.

The free turbine engine essentially is the same as the fixed turbine with the exception that the third-stage turbine is mounted on a separate co-axial shaft aft of the exhaust of the second turbine stage. Power takeoff is from this third turbine at the rear of the engine rather than from the front of the engine as in the fixed turbine model. Weight and cost of the free turbine is greater than the fixed shaft engine because of the extra weight and expense of the power takeoff method.

Question as to which type of engine, fixed or free turbine, is most suitable for helicopters revolves around the power output of the engine. Fixed turbines require a clutch so that the engine can be started without load. The arrangement with a fixed shaft turbine is similar to that used in helicopters powered by reciprocating engines. Free turbine engines do not require clutches but have inherently slower response rates because of the spin-up time of the power takeoff turbine. They are, however, heavier than the fixed shaft engine and slightly more complex.

Performance Ratings

Sea Level Standard Day Static

AiResearch Model TSE331-7

Ratings	Shaft Horsepower (min.)	Jet Thrust (lb.)	Engine Rotor rpm. (nom.)	Main Output Drive rpm. (nom.)	SFC lb./shp./hr.	Turbine Inlet Temp. Deg. F
Takeoff (5 min.)	500	38.5	40,950	6,300	0.619	1,735
Military (30 min.)	450	31.5	39,000	6,000	0.630	1,710
Normal (Max. Cont.)	400	31	39,000	6,000	0.651	1,611
90% Normal	360	30.5	39,000	6,000	0.675	1,533
75% Normal	300	29.5	39,000	6,000	0.735	1,423
Ground Idle	0	1	20,500	3,154	58 lb./hr.	750

Faster Response

For engines in the 500 hp. class, AiResearch contends that the fixed shaft engine has the advantage of faster response and less weight. Clutches for engines up to 500 hp. are not a particular problem. However, for larger engines, the free turbine will win out AiResearch believes, primarily because clutches become cumbersome for engines of higher than 500 hp.

AiResearch's Model 331 falls about midway in the range of engines produced by the company. Size of the turbine engine family ranges from engines of 2 to 9.5 lb./sec. air flow. The 331 has an air mass-flow of 4.32 lb./sec.

AiResearch has quoted prices of $19,000 each in 100-engine lots for the fixed turbine engine and $21,000 for the free turbine. Lot price on a military contract can be substantially reduced, AiResearch says.

USAF Grants

Air Force Office of Scientific Research recently awarded 60 grants and contracts totaling approximately $5 million to colleges, universities, nonprofit research institutions and industrial laboratories. Grants were to the following:

University of California, (UCLA), Berkeley, Calif.—$131,000 for adaptive control systems theory.

Catholic University of America, Washington, D. C.—$19,672 for research on flow separation.

Massachusetts Institute of Technology, Cambridge, Mass.—$29,975 for study of the physics of rarefied gas and plasma flows.

Brown University, Providence, R. I.—$36,665 for experimental and theoretical research in magnetic gas dynamics.

University of Virginia, Charlottesville, Va.—$126,778 for an electromagnetic suspension system for the measurement of aerodynamic characteristics.

University of Toronto, Toronto, Canada—$13,223 for magneto gas dynamics.

University of Toronto, Toronto, Canada—$23,532 for transfer of mass, momentum, and energy in free molecule systems.

Princeton University, Princeton, N. J.—$127,700 for combustion processes in liquid propellant rocket motors.

University of Utah, Salt Lake City, Utah—$34,160 for ignition and burning of solid propellants.

Leland Stanford, Jr., University, Stanford, Calif.—$37,880 for factors involved in the stability of cyclopropanes.

University of California, (UCLA), Berkeley, Calif.—$43,794 for light emitted by atomic flames.

University of Georgia, Athens, Ga.—$21,551 for a thermodynamic stability scale of stable, isolable free radicals.

University of Chicago, Chicago, Ill.—$51,018 for oxidation of aromatic compounds by electron transfer.

Fordham University, New York, N. Y.—$41,552 for small ring compounds.

New York University, Washington Square, New York, N. Y.—$65,780 for free radical aromatic substitution.

Pennsylvania State University, University

UTC

9 December 1961

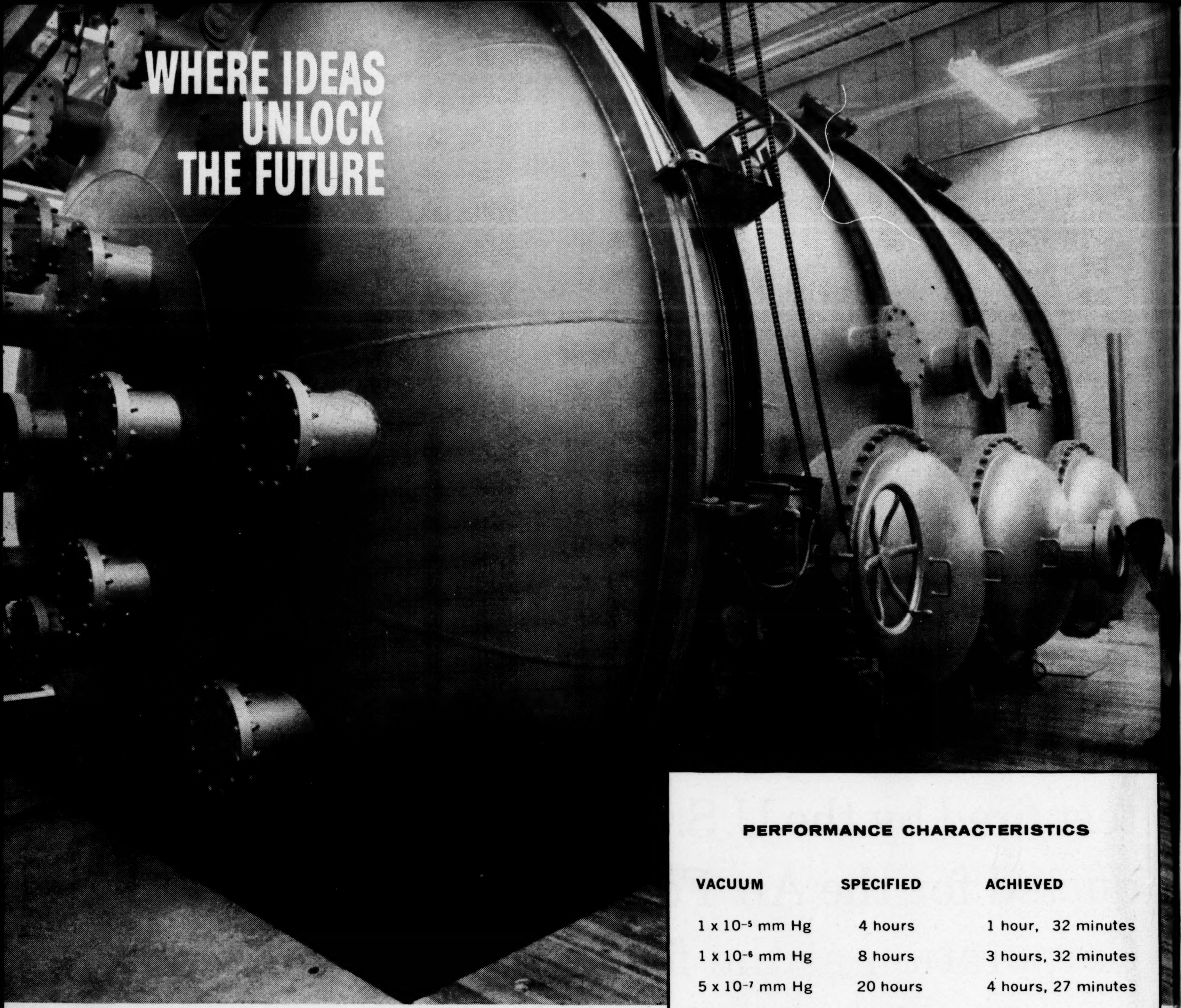
A prototype of a huge booster-size, segmented, solid propellant rocket motor was successfully test fired by the U.S. Air Force. The test was conducted for the Air Force by United Technology Corporation at the firm's Development Center near Morgan Hill, California. The giant rocket motor, which was designed and built by UTC, produced nearly a half million pounds of thrust.

UTC

United Technology Corporation

P. O. Box 358, Sunnyvale, California

SUBSIDIARY OF UNITED AIRCRAFT CORPORATION



COMPLETED AHEAD OF SCHEDULE, the Bendix 20′ x 27′ satellite test chamber is in operation! Vacuum and pumpdown exceed specifications. This high vacuum chamber is the heart of the new Bendix Space Laboratories for design, fabrication and test of complete satellite and spacecraft systems.

PERFORMANCE CHARACTERISTICS

VACUUM	SPECIFIED	ACHIEVED
1×10^{-5} mm Hg	4 hours	1 hour, 32 minutes
1×10^{-6} mm Hg	8 hours	3 hours, 32 minutes
5×10^{-7} mm Hg	20 hours	4 hours, 27 minutes
1×10^{-7} mm Hg	ultimate	7 hours, 32 minutes
5×10^{-8} mm Hg	beyond spec.	11 hours

SPACE ENGINEERS experienced in integration, assembly and testing of satellites will find new careers at the Bendix Space Laboratories. Specialists are needed for thermal-vacuum, vibration, structures, dynamics, radio and noise interference, fluids and mechanics, instrumentation, circuit design, and field test. Write or call Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division

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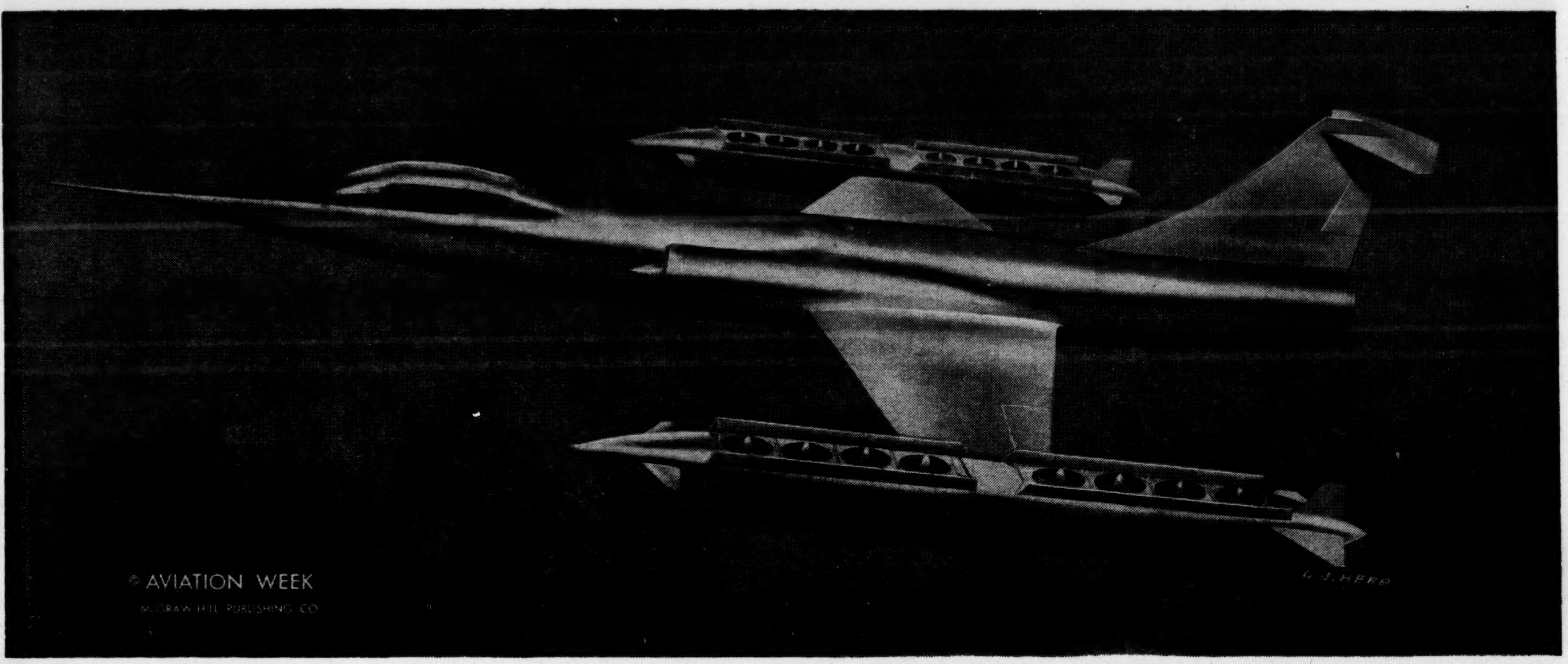


VTOL Fighter Concept Based on F-104

Aviation Week artist's conception shows a Lockheed Aircraft Corp. design which may be entered in the North Atlantic Treaty Organization VTOL fighter competition (AW Nov. 27, p. 28). Aircraft, basically an F-104 fighter, would have 16 vertical-lift turbojets in its wingtip pods (AW Sept. 26, 1960, p. 23). Lift engines would be Rolls-Royce RB.162s (6,000 lb. thrust).

Park, Pa.—$89,950 for chemical properties of labile species.

Washington State University, Pullman, Wash.—$44,032 for interactions of activated gases with solids.

McGill University, Montreal, Canada—$35,776 for variation of nuclear charge distribution in fission with bombarding energy.

Western Reserve University, Cleveland, Ohio—$28,310 for vasopressin biosynthesis.

University of Tennessee, Memphis, Tenn. —$45,000 for a study of basic gastrointestinal problems.

University of Delaware, Newark, Del.—$20,000 for effects of changes in group personnel upon group performance.

Northwestern University, Evanston, Ill. —$23,342 for simulation of communication and interaction.

Kansas State University, Manhattan, Kan. —$43,488 for predictability of task and long-term retention of learned skills.

University of Minnesota, Minneapolis, Minn.—$11,625 for problems in hydrodynamics and partial differential equations.

Institute of the Aerospace Sciences, Inc., New York, N. Y.—$24,235 for international aerospace abstracts.

University of Illinois, Urbana, Ill.—$19,361 for investigation of the relationship between curvature and homology in real and complex manifolds.

Johns Hopkins University, Baltimore, Md. —$25,205 for solutions of partial differential equations.

Harvard College, Cambridge, Mass.—$10,480 for probability, statistics, and mechanics.

University of Minnesota, Minneapolis, Minn.—$17,702 for the curvature of transformations.

University of Minnesota, Minneapolis, Minn.—$40,560 for fluctuation and multidimensional problems.

University of Missouri, Columbia, Mo.—$10,482 for nonlinear partial differential equations.

New York University, New York, N. Y.—$21,953 for research on mathematical problems.

William Marsh Rice University, Houston, Tex.—$5,598 for mathematical techniques for electric potential problems.

University of California, Berkeley, Calif. —$31,900 for research in atomic physics scattering processes.

University of California, Berkeley, Calif. —$35,000 for research in sampled-data control systems.

Yale University, New Haven, Conn.—$16,430 for density measurements in solid He^3.

University of New Hampshire—$18,605 for investigation of conduction theories in gaseous plasmas and solids.

Institute for Advanced Study, Princeton, N. J.—$1,200 for problems of the distribution and motion of interstellar matter in galaxies.

Yeshiva University, New York, N. Y.—$83,740 for statistical mechanics of transport properties in nonequilibrium and dissipative systems.

Leland Stanford, Jr., University, Stanford, Calif.—$90,000 for experiments and liquid helium temperatures on macroscopic quantum effects and general relativity.

University of Minnesota, Minneapolis, Minn.—$59,926 for electronic spin resonance studies of solid defects.

University of Georgia, Athens, Ga. —$35,991 for computer analysis of bio-electric response patterns.

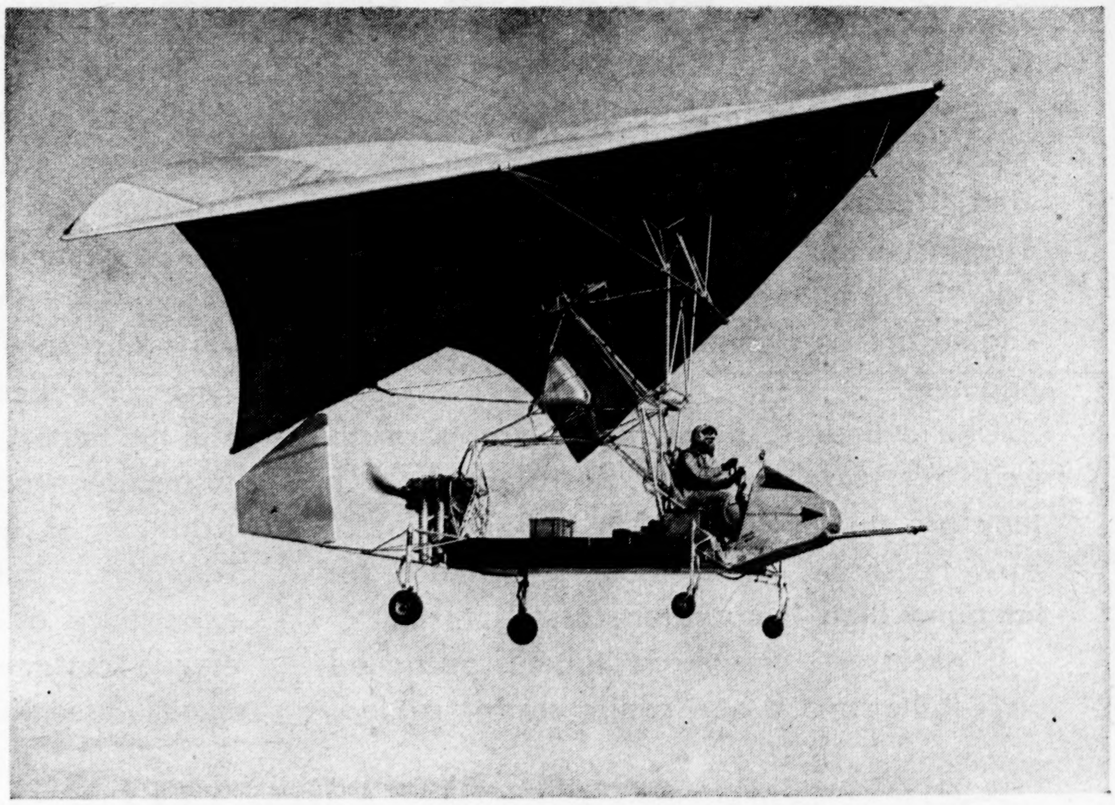
In addition to previously mentioned USAF grants the following contracts were awarded to educational institutions:

Leland Stanford, Jr., University, Stanford, Calif.—$38,902 for continuation of theoretical and empirical study of equilibrium and stability in irreversible processes with emphasis on problems in fluid flow.

Polytechnic Institute of Brooklyn, Brooklyn, N. Y.—$26,895 for continuation of study of vibrations of cylindrical shells.

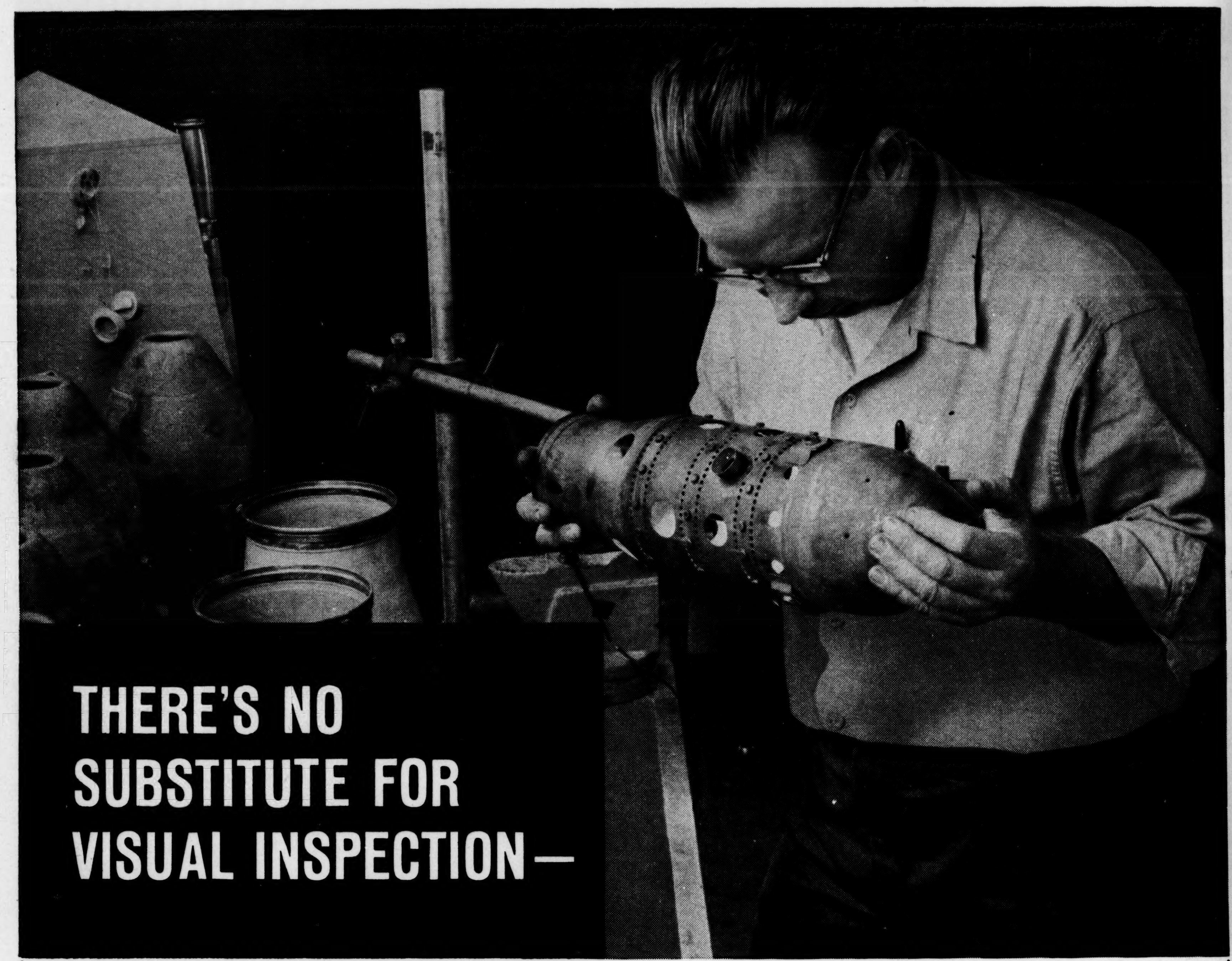
Cornell University, Ithaca, N. Y.—$34,290 for continuation of study of non-isenthropic gas dynamics.

Cornell University, Ithaca, N. Y.—$44,225 for continuation of study of kinetics of chemical reactions in shock tubes.



Wind Tunnel Tests Set for Flex Wing

Ryan Aerospace's Flex Wing test vehicle has completed the first two phases of flight testing for the Army Transportation Research Command. Aircraft—with rudder added to original design—is photographed here making final test flight over Brown Field, near San Diego. Vehicle now will undergo wind tunnel tests and continued flight tests, to be conducted by NASA pilots, in an Army-funded program at Langley Field, Va.



THERE'S NO SUBSTITUTE FOR VISUAL INSPECTION—

EVEN ON TURBINE ENGINES

Detailed, exacting visual inspection of Dart flame tubes is used to find cracked cooling rings, loose rivets and other discrepancies. The inspection is very precise — and very honest, for the flame tube is as vital to turbine engine life as cylinder condition is to piston engines.

Like cylinders, flame tubes are normally good for more than one operating cycle. If they are defective, they are repaired in the Airwork shops, using modern methods for handling high temperature metals.

If necessary, the flame tube is sectioned on a lathe, and a new center section added. Then the tube is rewelded under a blanket of argon gas to prevent oxidation of the sophisticated metal at high temperatures.

The volume of Dart engines handled by the Airwork shops, justifies the best available test and re-work equipment. But, in many cases, the best test equipment available is still the honest craftsmanship of well qualified inspectors; working for a company with a long tradition of quality. We offer you this at Airwork . . . and back it with the trouble-free experience of our many turbine and piston engine customers. Write for our new brochure, "Essential Aviation Services".

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Airwork
CORPORATION
Millville, New Jersey

PRODUCTION BRIEFING

Lycoming Division of Avco Corp. received its largest single engine production order from USAF–$21,406,117 for an undisclosed number of T53-L-9 turbines for Bell HU-1D helicopters. Order extends T53 production through October, 1963. The 480-lb. engine is rated at 1,100 shp.

Cleveland Pneumatic Industries, Inc., of Cleveland, Ohio, will provide 25 landing gear sets for Swiss American Aircraft Corp.'s SAAC-23, new twin-jet executive aircraft, which will go into production soon in Switzerland.

City Tank Corp., Culpeper, Va., has received a $605,000 contract from Port of New York Authority for 16 jet aircraft refueling units, each with 10,000-gal. capacity, for use at New York airports.

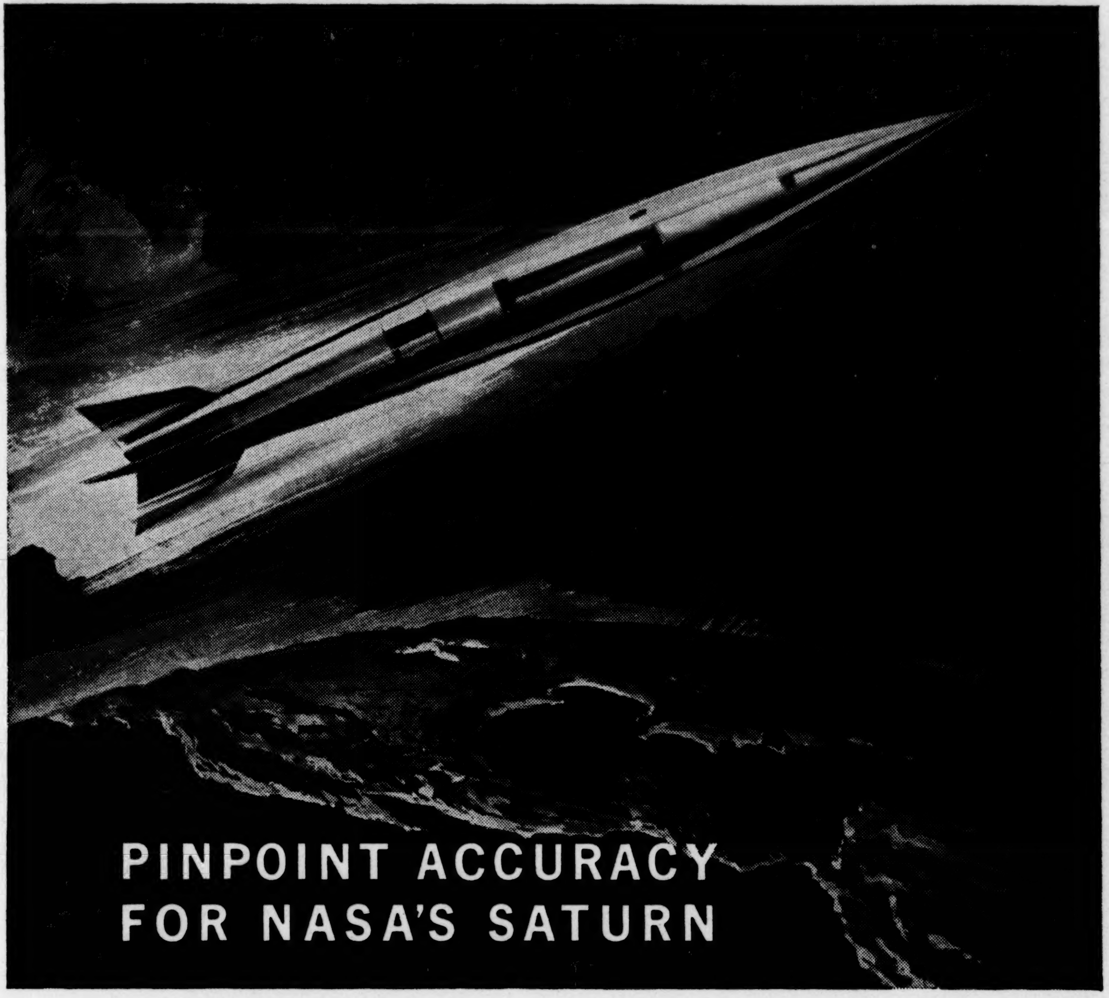
Belock Instrument Corp. of College Point, N. Y., has received contracts totaling $1 million for continued engineering and production of training simulators for Army Hawk missile.

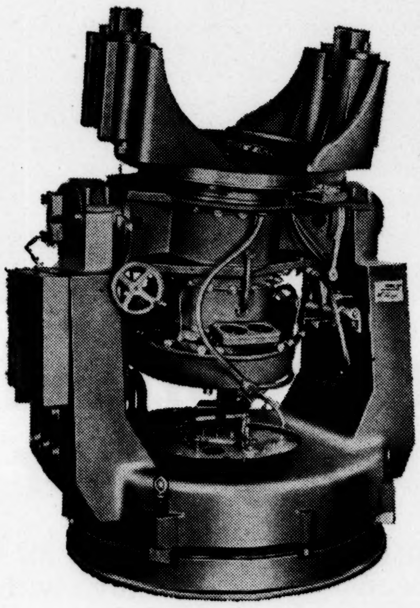
Varian Associates, of Palo Alto, Calif., will build a radiographic linear accelerator to be used by the Air Force for internal inspection of Minuteman and other solid-fueled missiles. The 26-million electron volt X-ray device, scheduled for delivery in mid-1962, will be installed at Hill AFB, Utah, as part of a $2.6-million Minuteman depot facility now under construction. The machine is expected to reduce Minuteman inspection time from 316 hr. to 13 hr.

Lear, Inc.'s, Instrument Division, Grand Rapids, Mich., has received a $2-million USAF contract to provide gyros and associated equipment for use in integrated flight panels aboard F-105 aircraft.

North American Aviation, Inc.'s Rocketdyne Division will produce 30 each of its Aerolus 1 and 1-90 solid propellant sounding rocket propulsion systems for evaluation by Navy's BuWeps. Aerolus 1 is designed to propel a 6-lb. payload to 230,000 ft.; Aerolus 1-90 is planned to push a 6-lb. payload to 90,000 ft.

Shielding, Inc., of Riverton, N. J., will construct an 8,500-sq.-ft. manufacturing, controlled environment facility for General Electric's Space Technology Center at Valley Forge, Pa., under a $320,000 contract. The complex, due for completion in mid-January, 1962, will consist of five rooms arranged in satellite fashion around a central clean room.





. . . by inertial guidance systems tested on

DUNN TURNTABLES

Precise directional accuracy of missile or space vehicles such as the SATURN depends on the gyros . . . which must in turn be precision-engineered.

Right now, Dunn Air Bearing Test Turntables are the only tables available capable of quick, reliable and accurate evaluation of the new generation of ultra-accurate inertial gyros.

Dunn T918 Turntable will be used to test the guidance system of the SATURN. Largest air bearing test turntable ever built, the T918 handles loads in excess of 500 lbs . . . tests gyros with drift rates of the order of 0.001°/hr.

Dunn Air Bearings are an advanced concept design with many varied applications in the aerospace field. We'd like to discuss your aerospace hardware needs . . . phone us at Cambridge direct: 491-3300.

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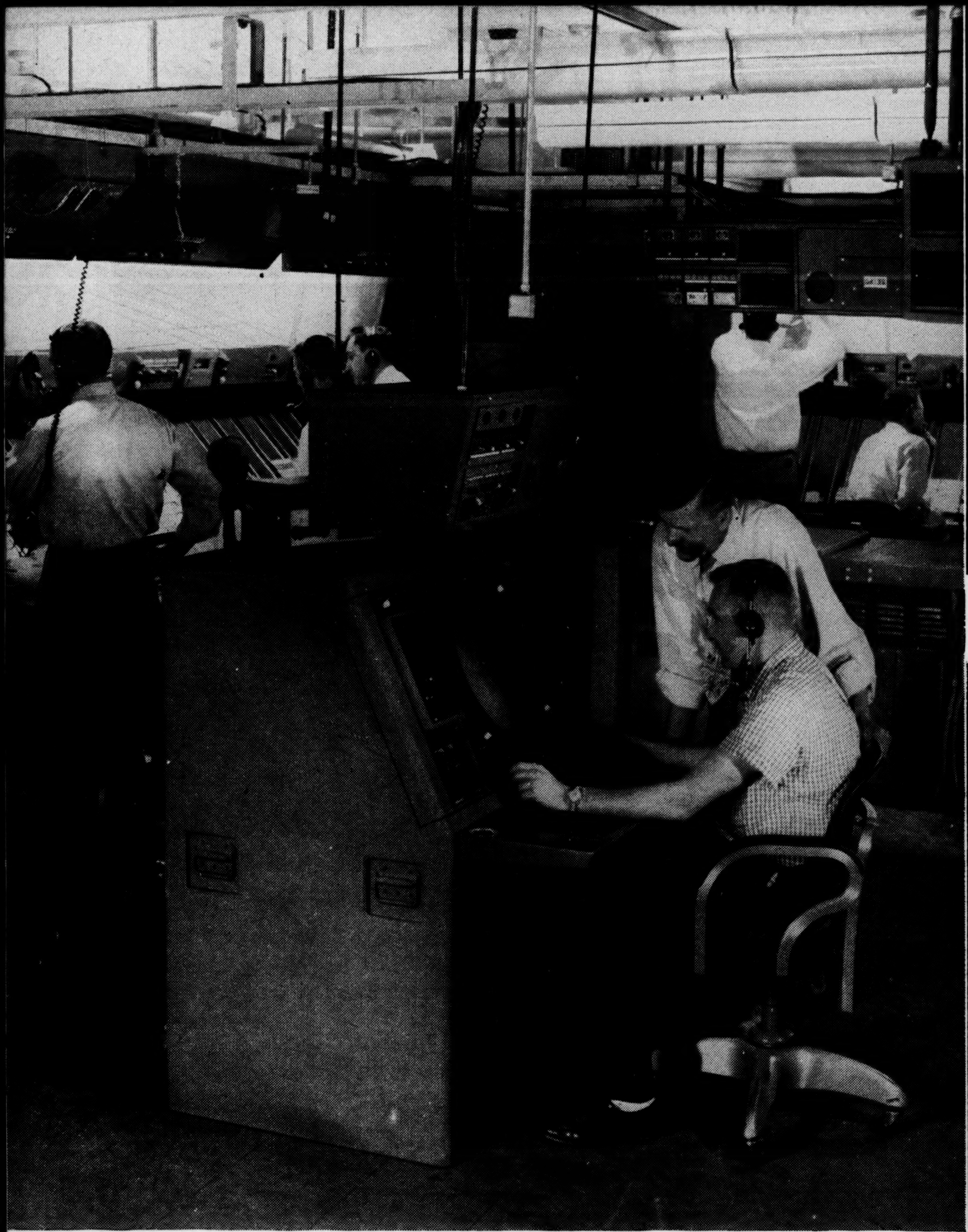
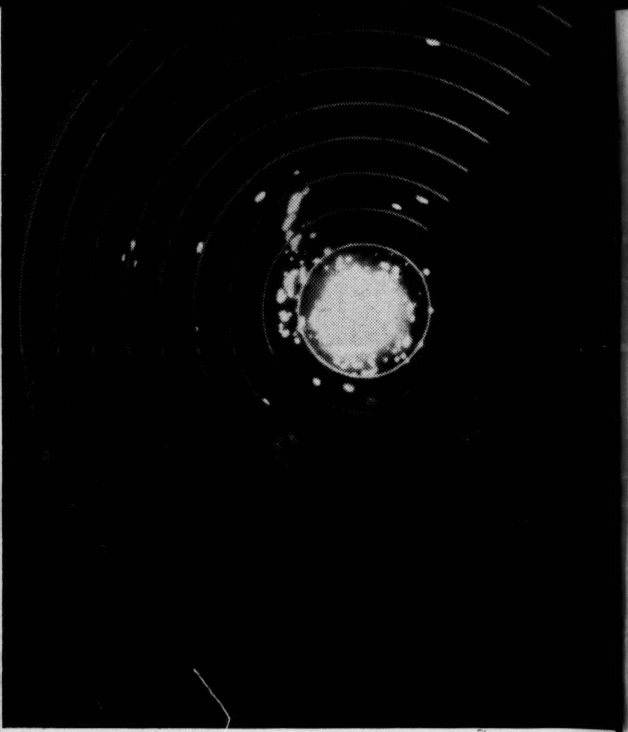
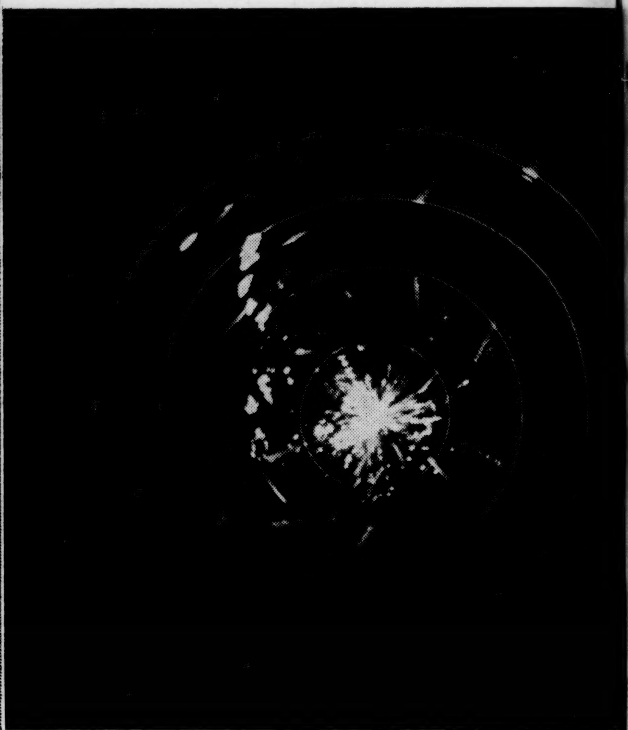






Unretouched photos show conventional radar with single target display (above) and Ray bright display with continuous target tracking (be

FAA orders new Raytheon bright display to further improve air traffic control

Raytheon's Radar Bright Display System, soon to be operational after three years of development, will mean safer transport for the flying public and greater traffic-handling capacity with existing control facilities. Features include —

SCAN CONVERTED DISPLAY

☐ Clearly visible under normal room lighting
☐ Target movements self-plotted in true position on map coordinates
☐ Adjustable memory, able to retain target signals for minutes
☐ Multiple location monitoring displays readily available
☐ TV-transmissible picture
☐ Instant image erase and rewrite within 2 seconds

POSITIVE AIRCRAFT IDENTIFICATION

☐ Sharp, bright flight tracks, displayed in real time
☐ Adaptable for identification symbols that lock-on and move with target
☐ Unmistakable hand-off assignments

RELIABLE PERFORMANCE

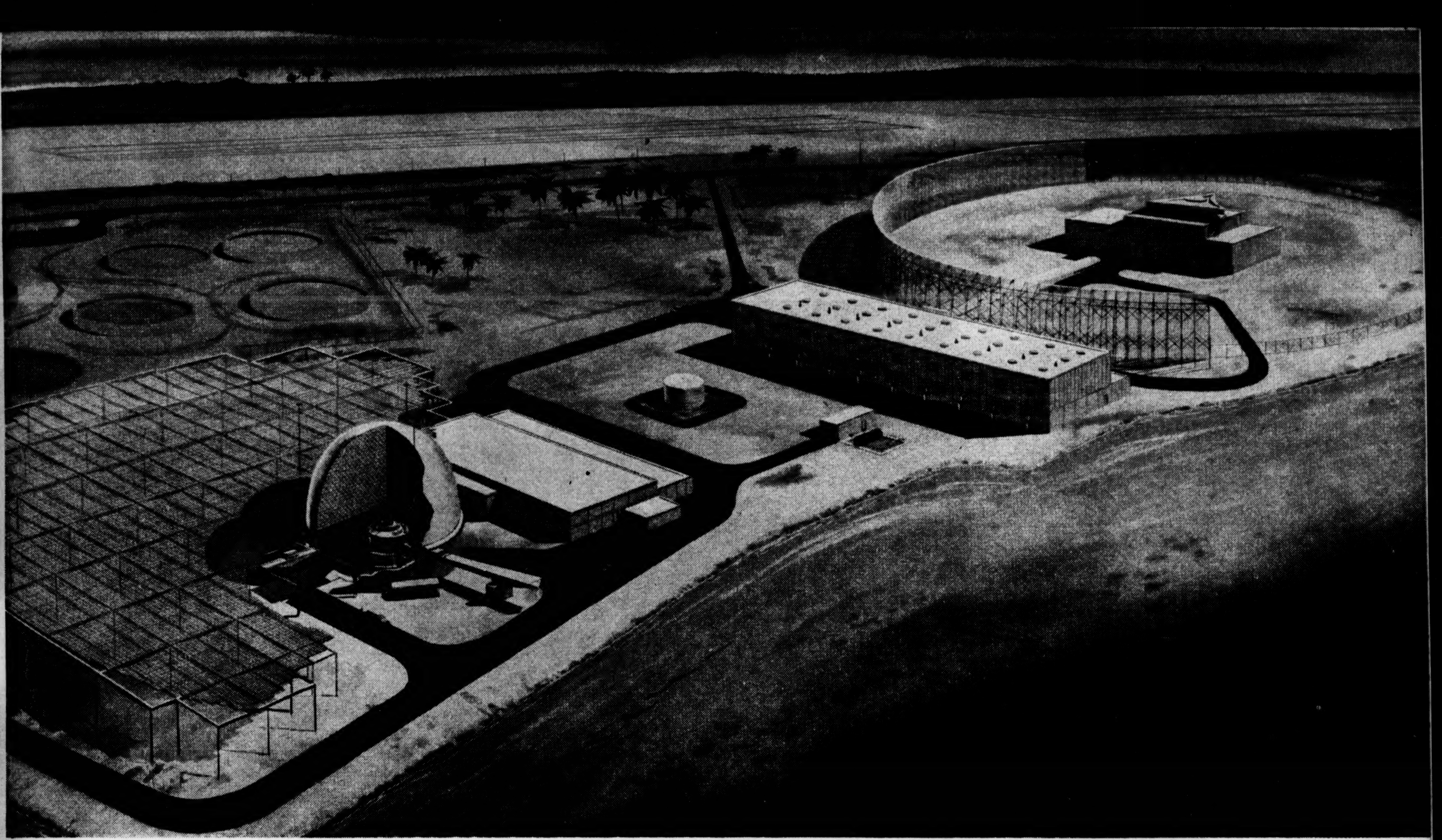
☐ Transistorized circuitry
☐ Light, compact, sturdy construction
☐ Low heat generation
☐ Simplified servicing

The Federal Aviation Agency has ordered 51 RBDE-5 equipments for control centers from Hawaii to the East Coast. Their advantages are available for radar, sonar, computer output and other display applications, to meet either Military specifications or the most exacting commercial requirements. For full technical details on Raytheon Scan Conversion Bright Display Systems, write: *Raytheon Company, Dept. 72, Lexington 73, Massachusetts, Attention: M. B. Curran*

RAYTHEON COMPANY

RAYTHEON

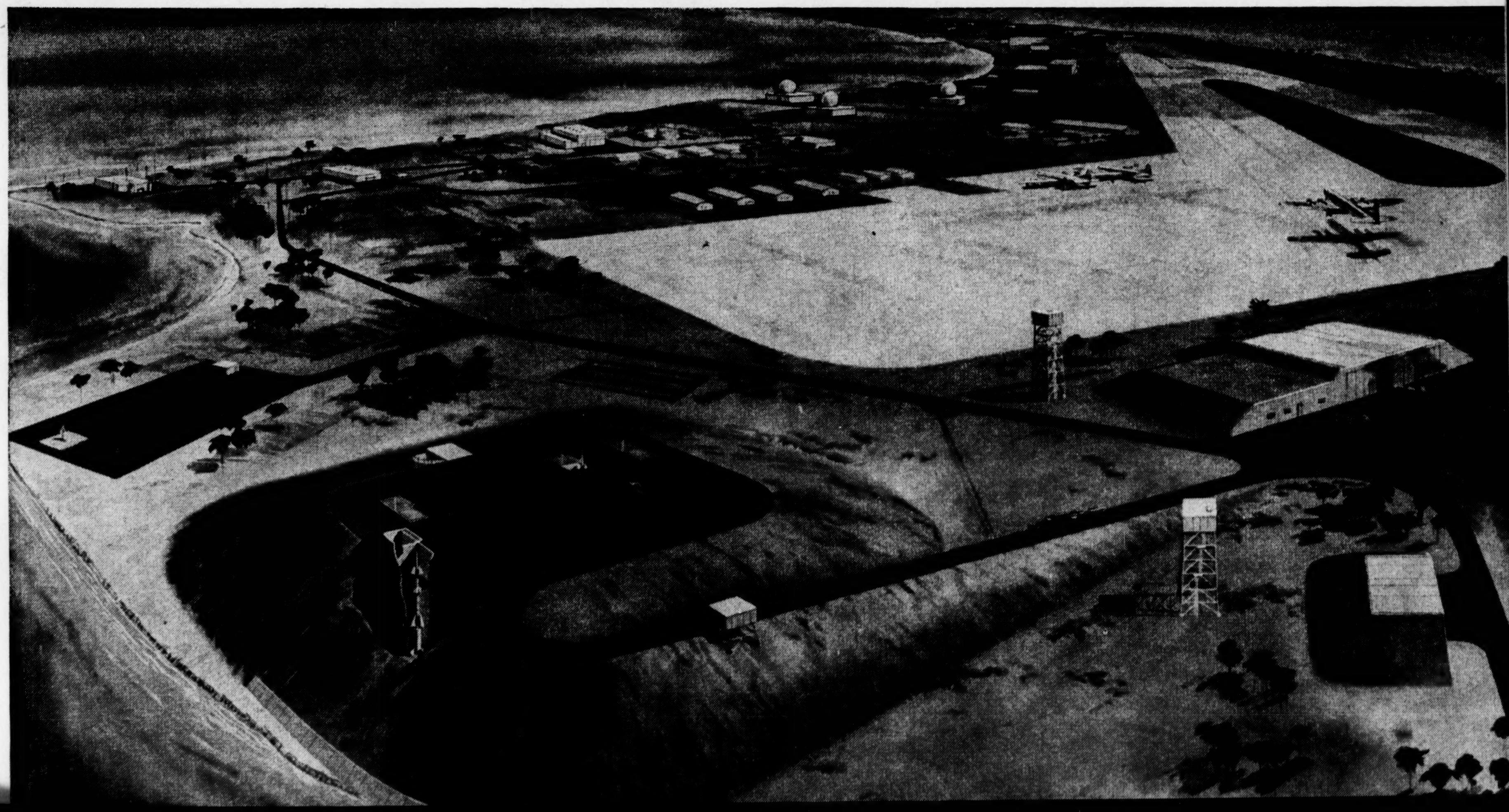
EQUIPMENT DIVISION

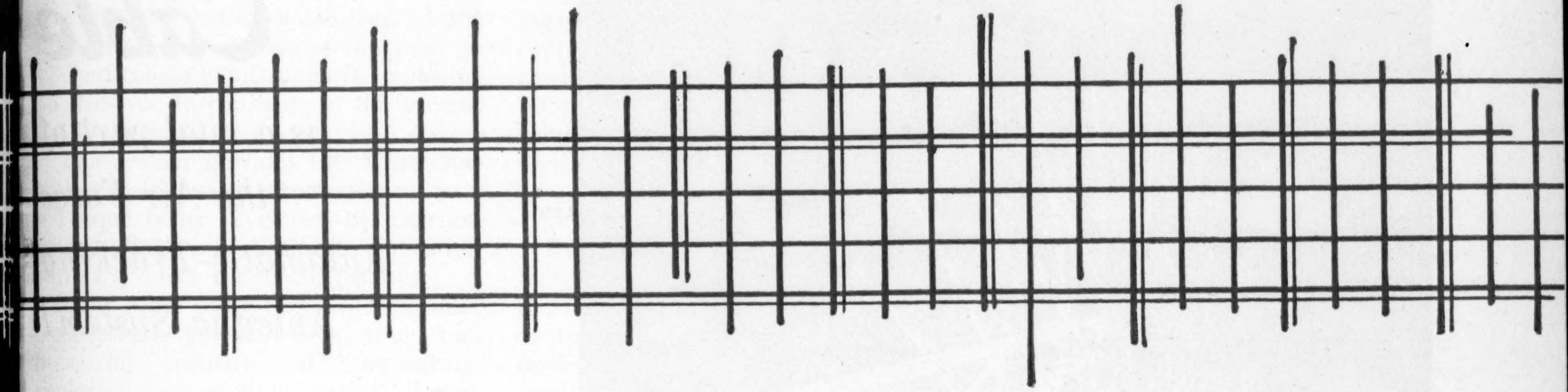


Artist's rendition of facilities at Kwajalein Atoll in the Pacific indicates that construction changes are under way to extend coverage for the long-range acquisition radar of the Nike Zeus anti-ICBM system from the present 150-deg. sweep for the forthcoming Nike Zeus/Atlas target trials to a complete 360-deg. coverage. The circular, 65-ft. high, beam-forming mesh fence (upper right, top photo), serves to eliminate ground clutter and affords biological protection from antenna radio frequency emissions. Transmitter antenna is located on top of the transmitter building and is surrounded by the beam-forming fence circle. Adjacent to the fence is powerplant building for the installation. Screen deck (left), adjacent to the hemispherical radar receiver antenna will be extended out over the road and will surround the dome and cover the receiving building at its right. Radar receiver antenna consists of a rotating hemispherical Luneberg lens, is built up of more than 34,000 media blocks of foam plastic loaded with metal filaments to control dielectric constant to give the desired refraction of the radar frequency. Three horn towers embedded in the outer surface of the hemispherical shell are 120 deg. apart and each consists of about 50 banks of receivers reaching up along the curved surface from the base of the hemisphere almost to the apex (AW Apr. 17, p. 75). Cutaway shows the axle center bearing for rotation of the hemisphere.

Kwajalein Nike Zeus Radar Extension Planned

Artist's version showing Nike Zeus missile in cutaway of silo type launch cell indicates deployment scheme for the anti-ICBM on Kwajalein's 63-ft. high "Mt. Olympus." Deflector at the bottom of the missile launch cell deflects the exhaust into an adjacent duct and up to the surface. Four launch cells are deployed in the complex and incorporate a five-degree cant to the south so that the missile or its fragments will not fall back onto the launch area if a failure occurs immediately after liftoff.





genus: homo · species: sapiens
discipline: factors engineering

At the six major RCA Defense Electronic Products facilities, teams of psychologists and design engineers are deeply involved in the highly specialized, incredibly complex study of human factors engineering—man/machine interfaces, auto-instructional methods, decision processes, read-in/read-out optimization techniques, sensory perception, the entire spectrum of psychological-physiological-physical disciplines.

Whether your requirements involve human factors study of command and control functions for defense networks, or projected life support systems for space exploration, a total RCA capability stands ready to assist you . . . from feasibility study to project completion. Write Defense Electronic Products, Radio Corporation of America, Camden, N. J.

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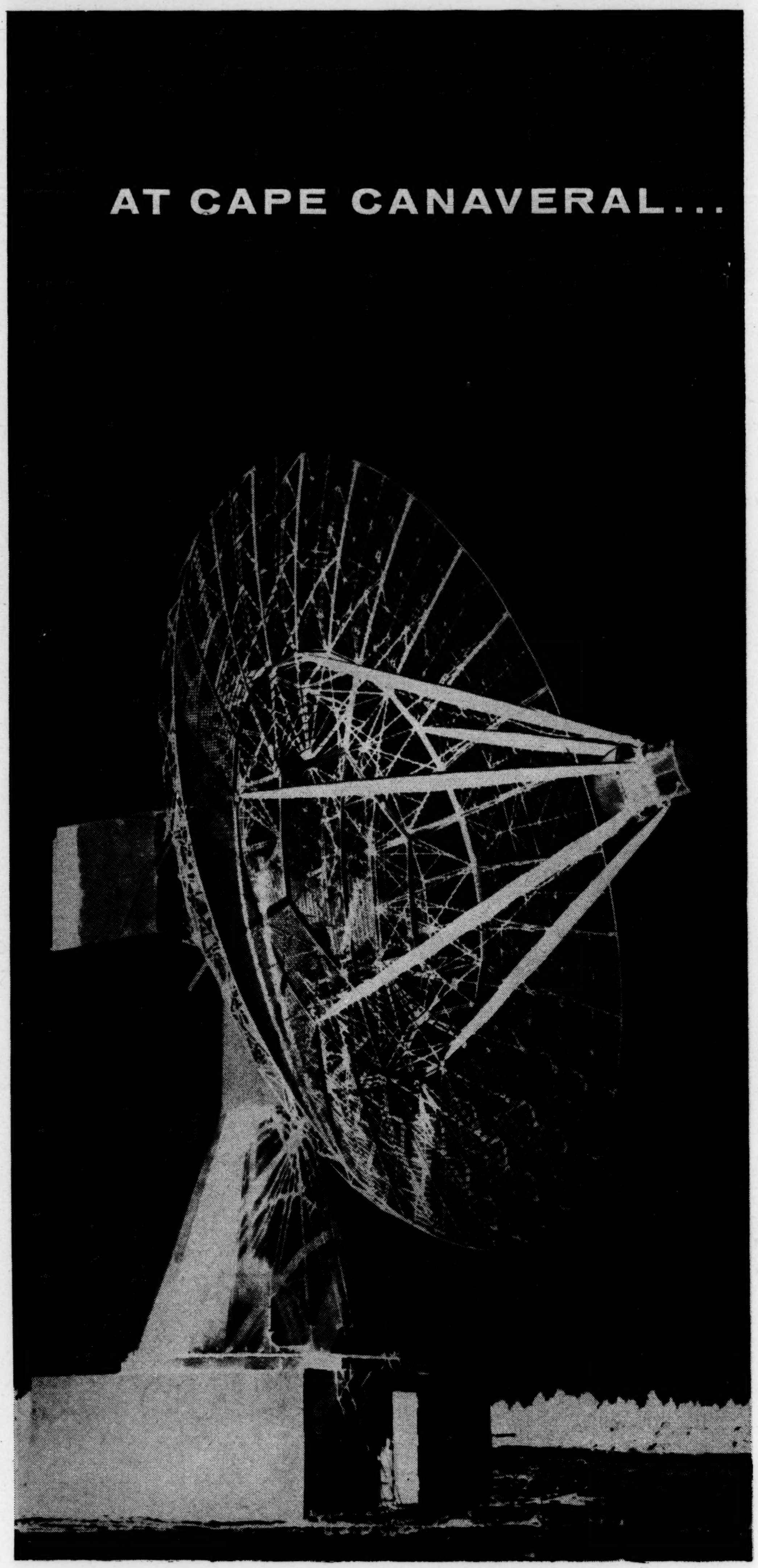
AT CAPE CANAVERAL...

Styroflex® Coaxial Cable

is a vital part of the Air Force Automatic-Tracking Antenna System!

The powerful TLM-18 telemetry antenna now in service at the Air Force Missile Center, Cape Canaveral, Fla., is used for the automatic tracking of missiles and earth satellites. This huge "mechanical ear," specifically designed by Radiation, Inc., Melbourne, Fla., has an effective data reception range of over 1000 miles.

One of the key parts of this highly sensitive device is the ⅞", 50 ohm, aluminum sheathed Styroflex® coaxial cable that links the 60-foot parabolic reflector to the receivers. The task of carrying missile-to-earth signals from the antenna to the control building demands a low-loss, high frequency cable with a high signal to noise ratio.

The remarkable characteristics of Styroflex® cable not only meet these rigid specifications but also have extra operational advantages, including long operating life under severe conditions and stable electrical properties during wide temperature variations.

Styroflex® coaxial cable has earned an outstanding record for these qualities in a variety of industrial, mass communication and telemetering applications. Perhaps this cable can answer your particular high frequency cable problem. We invite your inquiry.

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P D MINE TO MARKET

Display Consolidates C-130 Engine Data

By George Watson

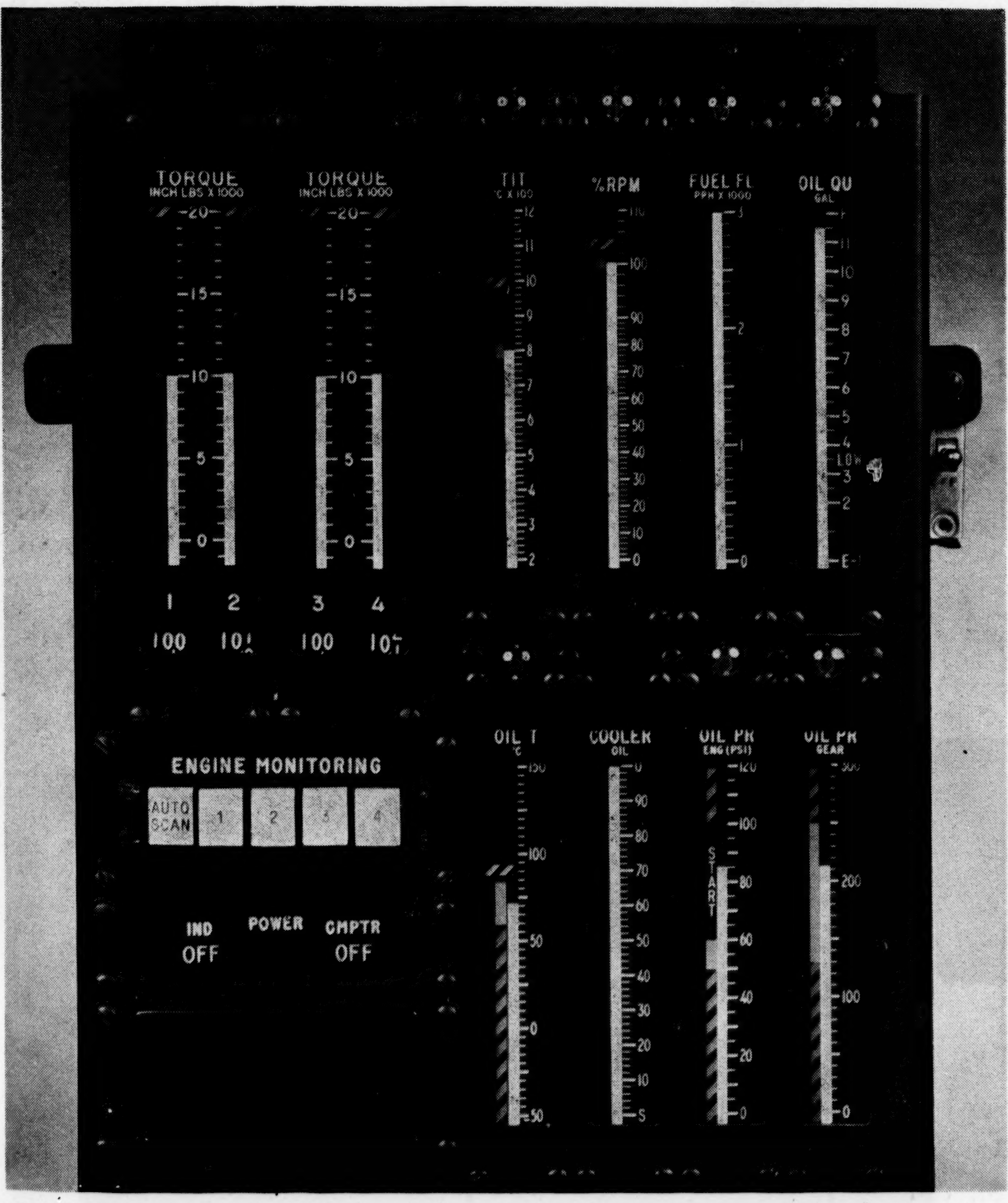
Teterboro, N. J.—Simplified cockpit display system which monitors engine performance using digital techniques has been developed by Eclipse-Pioneer Division of Bendix Corp. for the Lockheed C-130 military transport. The system presents critical parameters of the transport's four turboprop engines on 12 vertical-scale instruments, replacing 36 dial-type instruments in the present C-130 system.

The system provides the flight crew with the following information:

- **Torque** being developed by each engine, both as a vertical-scale indication and as a direct numerical readout.
- **Eight other parameters** (turbine inlet temperature, per cent rated rpm., fuel flow, oil quantity, oil temperature, cooler oil door opening, engine oil pressure and gear oil pressure) on a worst-case basis. Of the four values of a particular parameter available at any one instant, the system displays the value representing the worst engine performance.
- **Acceptable operating limits** dictated by safety requirements.
- **Malfunction indication**, specifying the engine and parameter for which an acceptable operating limit has been exceeded.
- **Optimum operating value** or range of values considered ideal for the prevailing flight conditions or throttle setting.

Designed for Quick Scan

By presenting information in essentially bar-graph form, the system allows the flight crew to check for uniformity of torque, optimum performance and malfunctions by quickly scanning the engine instrument panel. Quantitative data can easily be read from the scales.



PROPULSION DATA display panel shows magnitude of parameter (white bars), optimum operating range or points, and safe operating limits (striped flags and bars).

The magnitude of a parameter is indicated by the height of the white area on a black-and-white tape. Acceptable operating limits are shown by red-striped flags or bars. Optimum operating values are shown by green indices, optimum ranges by green bars.

Electroluminescent Lighting

An unusual feature of the system is electroluminescent illumination for night operation. A white electroluminescent panel is located behind the scale of each instrument. Light from this panel passes through the translucent scale graduations and numerals, indicator tape, and acceptable operation and optimum operation indicators. The acceptable operation limit flags, which have several positions, have separate electroluminescent devices. The white, green, and red color code is the same as for daylight operation.

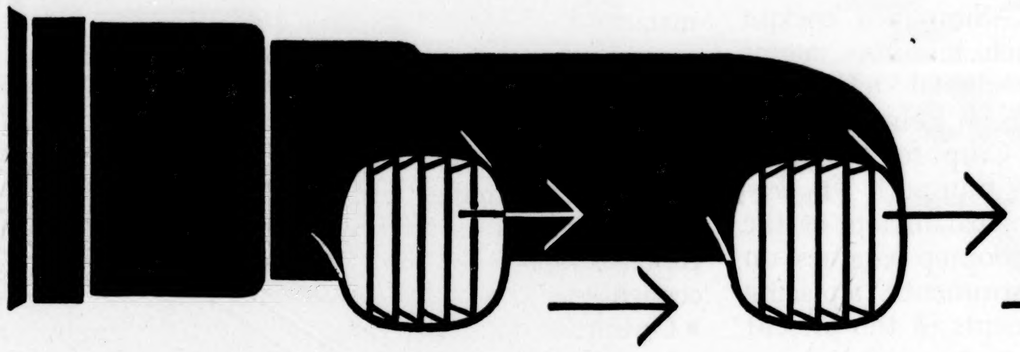
According to John Sadvary, assistant senior engineer at Eclipse-Pioneer, development of electroluminescent lighting having the required color, intensity range, uniformity and long life was a significant portion of the system development program. Life expectancy of the electroluminescent panels is 2,500 hr., Sadvary estimated.

System Operation

Basically, the system operates as follows:

- **Signals from nine sensors** in each engine (36 signals in all) are fed to the system input control, which sequentially selects each of the signals as the input to the computer.
- **Analog signal** is converted to digital form; that is, the sensor signal, a voltage proportional to the magnitude to the sensed parameter, is converted to binary-coded pulses representing the magnitude of the parameter. This information then is stored in a temporary memory.
- **Information** on acceptable (safe) operating limits is fed into the temporary memory from a permanent storage memory.
- **Parameter is compared** with acceptable operating limits. If the parameter is out of limits, a panel light over the appropriate instrument notifies the flight crew of the malfunctioning engine.
- **Parameter is compared** with the same parameter for another engine, and the worst-case parameter stored. The procedure is repeated, comparing the same parameter for the remaining two engines, and the poorer value of the two sorted. Finally, the two stored values

BS AERO POWER



SIMPLIFIED POWER

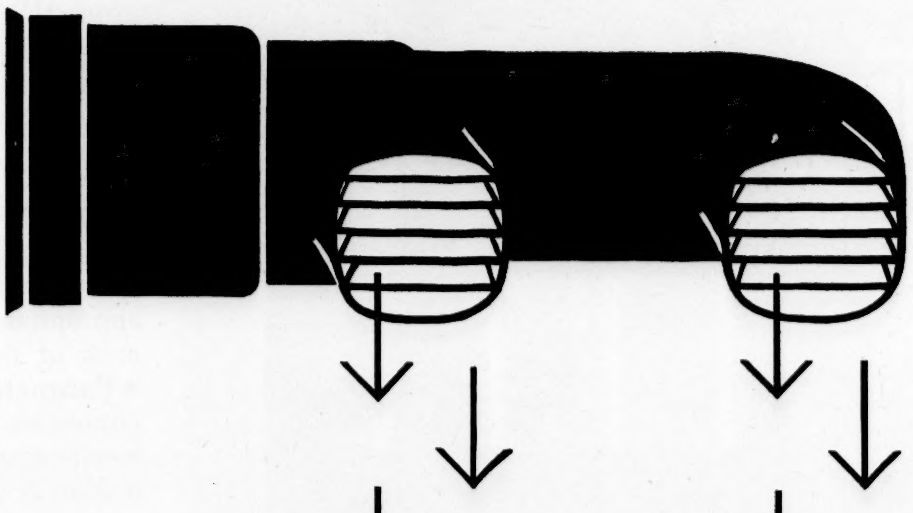
Because Bristol Siddeley lift/thrust turbofans enable the total thrust to be used for lift and propulsion, they provide the optimum power unit for all V/STOL applications. They represent the only practical solution for a single-engine aircraft; with the advantages attendant on extreme simplicity.

Used with separate lifting engines, they permit a simpler and more economical solution than can be achieved with a combination of separate lifting and propulsion engines.

SINGLE-ENGINE INSTALLATION

Simplicity resulting from:—

- The resultant thrust and intake drag passing through the centre of gravity.



V/STOL STRIKE AIRCRAFT

- ✱ Maintenance and spares requirements being confined to one engine.
- ✱ Availability of large power reserve for acceleration and manoeuvre.

MULTI-ENGINE INSTALLATION

Simplicity resulting from:—

- ✱ Requirement for fewer specialised lift engines, as the total propulsive power is also available for take-off.

SUPERSONIC FLIGHT

In Bristol Siddeley lift/thrust turbofans fuel can be burned in the by-pass ducting or plenum chamber to give a thrust boost for take-off and supersonic flight. This plenum chamber burning permits:—

- ✱ A large-thrust boost for supersonic speeds with only a modest increase in specific fuel consumption.
- ✱ Engine performance matched to aircraft cruise requirements.
- ✱ Greater thrust for transonic acceleration.
- ✱ Greater radius of operation.

These thrust boost advantages are achieved more economically by plenum chamber burning than by reheat in the hot exhaust gases.

The development of Bristol Siddeley lift/thrust engines is supported by the US Government through the Mutual Weapons Development Programme.

BRISTOL SIDDELEY ENGINES LIMITED

For further information, please write to: Bristol Aero-Industries Limited, 10210 Pie IX Boulevard, Montreal North, PQ, Canada.

are compared, and the worst case selected. A transfer mechanism connects the sensor producing this value to the display instrument.

- **Optimum operation data** is derived from two memories. Optimum engine speed (per cent of rpm.) depends on a single variable—throttle position—and is stored in the diode-matrix memory used for storage of acceptable operating limits. Optimum torque and turbine inlet temperature depend on several variables, and are stored in a specially-developed optical memory. This data, after digital-to-analog conversion, is displayed on the instruments.

Input Sequences

The sensor input sequence is clocked by the aircraft's 400 cps. electrical power frequency. The input control selects the parameter, then switches the four values of that parameter into the computer. The input control allows four cycles for the measurement of each input. Analog-to-digital conversion begins at the start of the third cycle to permit settling of switching transients. Processing of the digital signal begins at the start of the fourth cycle. Total measurement time is 10 milliseconds, with 2.5 milliseconds allowed for actual computer operations.

The flight crew can override the input control by depressing one of four engine monitoring buttons on the instrument panel. This bypasses the automatic switching sequence, and connects the sensors of the engine selected directly to the instruments. The other computer functions—malfunction, acceptable operation, and optimum operation indication—continue to operate.

The optical memory used for storage of variable flight data eliminates the need to compute optimum performance from flight charts. Optical storage techniques were selected because this approach offers greater compactness, and has non-destructive, high speed (fractional microsecond) readout. In Sadvary's opinion, the Eclipse-Pioneer optical memory is smaller by a factor of 10 than an equivalent-capacity memory using more conventional techniques.

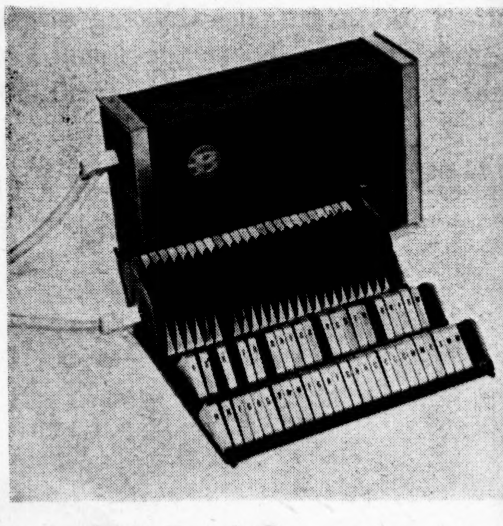
The heart of the memory is an opaque glass disk containing data in the form of short transparent lines in concentric rings. The disk, driven by a high-speed synchronous motor, rotates past narrow beams of light (one for each concentric ring) on one side, and opposing photodiodes on the other side. The resulting pulses of light are converted to electrical pulses by the photodiodes.

The disk contains a start track, a clock track and several function tracks. The start track (the innermost ring) has only one line, which provides a reference pulse to signify the start of a readout cycle. The clock track (the outermost ring) consists of uniformly spaced rectangles which furnish timing pulses for readout and associated logic operations.

The function tracks contain irregularly-spaced lines representing torque as a function of altitude, dynamic pressure, fuel flow, and turbine inlet temperature, and turbine inlet temperature as a function of altitude, airspeed, and dynamic pressure. To determine optimum levels of torque and turbine inlet temperature, the actual values of the variables are supplied to the optical memory. The memory notes the slope and intercept of the function at the next higher increment of the variable and interpolates to find the function at the actual value of the variable. This value, after digital-to-analog conversion, is displayed on the instrument panel (as an index in the case of torque; as a narrow range in the case of turbine inlet temperature).

Less Panel Space

In addition to simplifying propulsion data display, the Eclipse-Pioneer system requires less panel space than the present dial-type display. The new panel is approximately 10 in. wide and 13 in. long—5 in. shorter than the dial indicator panel. The remaining 10 x 5 in. area is expected to be used for another system. However, size and weight of the over-all system have necessarily been increased. Weight is 50 lb., divided about equally between computer and indicator panel.

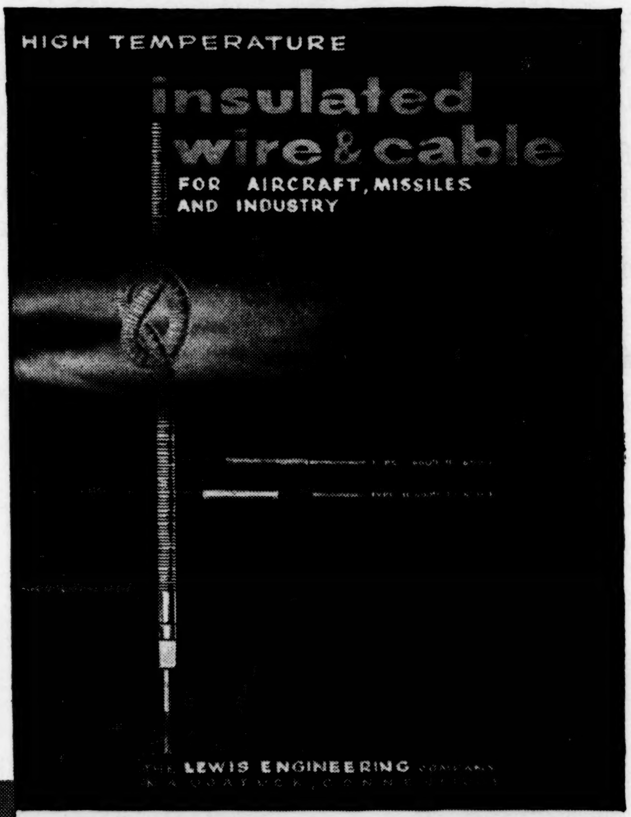


Digital Computer

Miniature digital computer built by Burroughs Corp., measures only 3 x 6 x 11 in., weighs 12 lb., can perform 33,000 mathematical operations per second. Computer called Macro-Module and Digital Differential Analyzer Machine (MADDAM), has clock rate of ½ megacycle. MADDAM achieves component density of 69,000 per cubic foot using conventional miniature components mounted on triangular shaped circuit boards, called chips (AW Mar. 21, 1960, p. 67). Chips fit snugly between fins of water-cooled heat exchanger.

DESIGNERS and ENGINEERS:

write for this brand new data on flexible, high temperature resistant wire and cable for hypersonic vehicles, or special industrial applications.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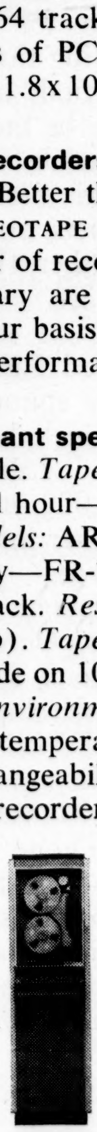
kes 4 mc response to fully encompass all bove applications. Increasing tape speed static heads would demand 1,300 ips and rd only 3 minutes, using massive 19" reels ut Ampex puts a full hour on standard " reels, by *rotating the recording heads* at 00 rpm transversely across slow-moving (12½ and 25 ips) to get the needed rela- head-to-tape speed for 4 mc. In so doing, R-300 and FR-700 recorders borrow from ex's VIDEOTAPE* Recorders, which use an ical technology to capture TV frequencies.

bits per hour, another bonus from rota- heads. Rotating heads reconcile two ideals: ive freedom from information dropout, maximum information recorded per reel pe. With head-to-tape speed to spare, each f information can be permitted to occupy ater wave length along the track to mini- dropout. At the same time, rotating heads deal for recording very narrow, closely- d tracks across the tape. This narrow ng puts 64 tracks into each inch. Up to),000 bits of PCM data can be recorded econd, or 1.8 x 10^{10} bits on a one-hour reel.

similar recorders have written the relia- record. Better than 99% reliability from 750 VIDEOTAPE Recorders in worldwide s a matter of record. Sole routine replace- s necessary are heads and tapes. On a cycle-hour basis, life compares favorably lower performance recording methods.

e significant specifications. One or two s available. *Tape speeds:* 12½ ips for sin- rack and 1 hour—25 ips for two tracks and our. *Models:* AR-300 Mobile or Airborne cord only—FR-700 single rack laboratory rd/playback. *Response:* by FM 10 cps to c (± 3 db). *Tape:* 1.0 mil Mylar (DuPont .), 2" wide on 10½" reels. *Electronics:* all state. *Environmental* (AR-300): 50,000 altitude, temperatures −54°C to +55°C. e interchangeability between all AR-300 FR-700 recorders.



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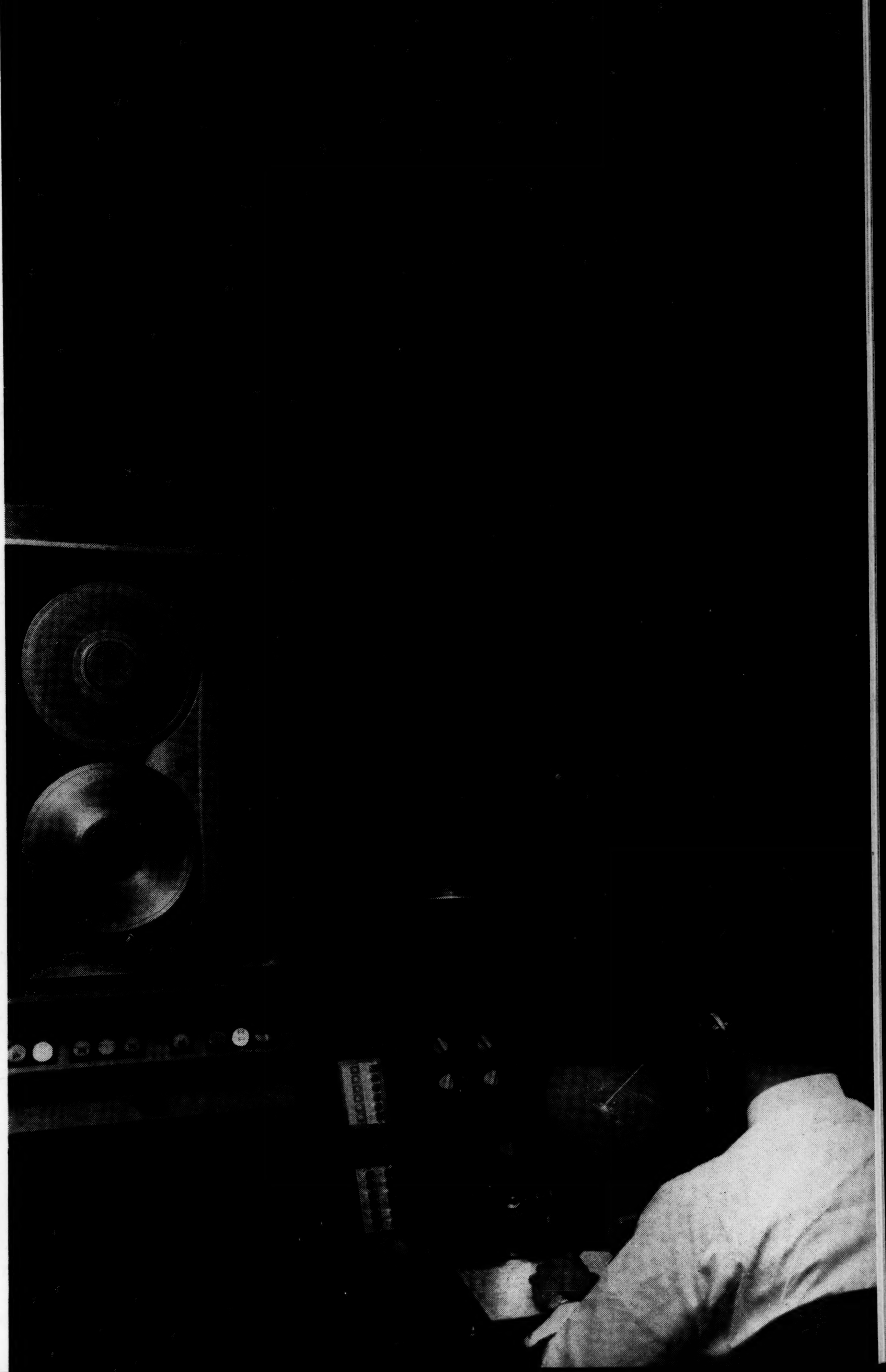

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ANALYSIS • DESIGN • TESTING • MANUFACTURING

FILTER CENTER

▶ **Raytheon Forms Japanese Company**—New company to be set up soon in Tokyo to produce microwave tubes, known as the New Japan Radio Co., will be jointly owned by Raytheon and Japan Radio Co., Ltd., with latter holding controlling interest.

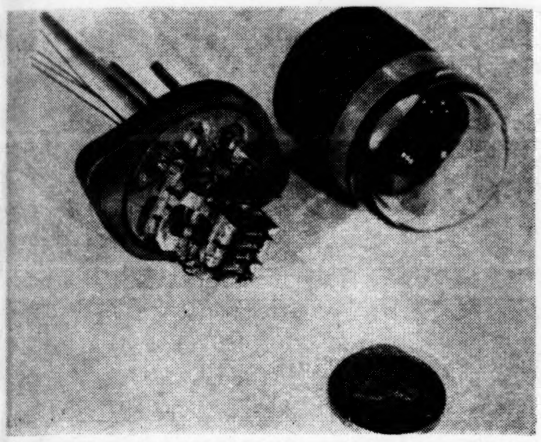
▶ **Call for Reports**—Solid State Electronics Laboratory of University of Denver's Research Institute will sponsor 1962 Conference on Thin Films, to be held Aug. 29-30 in Denver. Sessions will cover magnetic films, epitaxial growth, and general film properties. Abstracts of 300 to 600 words should be submitted before Apr. 1 to R. B. Feagin, Denver Research Institute, University of Denver, Denver 10, Colo.

▶ **Radiation-Resistant Active Components**—New type of active thin film avionic component which could substitute for and be superior to transistors and electron tubes in its ability to withstand particle and electromagnetic radiation encountered in aerospace environments will be the object of a research and development study contract to be awarded early next year by Diamond Ordnance Fuze Laboratories. The devices to be investigated may be based on the tunneling effect or any other radiation resistant phenomena capable of giving the device the ruggedness, small size and lifetime satisfactory for operation in earth satellites traveling through the Van Allen belts for periods up to five years. The devices may be individually packaged or be compatible with thin film passive circuitry in microcircuits. Proposals for two contracts, one emphasizing materials, the other theoretical studies, are due on Jan. 2.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

- **Sylvania's Waltham Laboratories**, Waltham, Mass., $48,000 award for electroluminescent weather information data display for Air Force.
- **United Aircraft** Corporate Systems Center, Windsor Locks, Conn., $1.6-million Air Force contract for stellar-inertial guidance system development.
- **Lear, Inc.**, Astronics Division, Santa Monica, Calif., $1.2-million award from Navy for guidance and electrical system components for Dash (Drone anti-submarine helicopter) weapon system.
- **Westinghouse Air Arm Division**, Baltimore, Md., $2.2-million Navy contract for repair parts for underwater launch and sea energy recorder system for Polaris missile.

NEW AVIONIC PRODUCTS



• **Radiation resistant wirewound resistors,** Series N, have demonstrated stability under gamma and neutron irradiation. In separate tests, two resistors (1 kilohm and 100 kilohms) were subjected to a total gamma radiation exposure of 1.9 x 10^{15} ergs/gm(C) at 55C, and to a total exposure of 1.48 x 10^{15} neutrons (of energy greater than 2.9 Mev) at 55C. In both cases, measurements revealed no difference between initial and post-irradiation resistance values. N-series resistors are alkyd encapsulated, and are available with axial, radial, or special leads. Tolerance of ±0.005%, stability of 0.001% per year, and temperature coefficient of zero ±2 ppm/°C over a wide temperature range, are available. Manufacturer: Ultronix, Inc., San Mateo, Calif.

• **Integrated flight angle sensor** and pressure probe measures angle of attack, yaw angle, and pitot-static pressures in subsonic and supersonic flight, at altitudes to 60,000 ft. Available in pitch and yaw ranges of ±5 to ±20 deg, with resolution of 0.25 deg., the instrument is 13.56 in. long, weighs 0.75 lb. (without mast). Manufacturer: Giannini Controls Corp., 1600 S. Mountain Ave., Duarte, California.

• **Switch, 1PB3000 Series,** produces a single square wave pulse factor adjustable in duration from 30 to 500 milliseconds and in amplitude from 6 to 55 v. Switch incorporates circuitry to eliminate special pulse input circuits for high speed electronic switching devices. Temperature operation is rated from zero to 55C. Manufacturer: Micro Switch Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

• **Millimeter wave circular waveguides,** for operation in the low-loss TE_{01} mode, are available in a variety of complex bends. A typical right angle waveguide has 3 in. radius and 0.3 db. loss at 70 kmc. Manufacturer: TRG, Inc., 9 Union Square, Somerville, Mass.

• **Thermoelectric spot cooler,** F-3DC, a three-thermocouple cooling unit which can produce a 65C temperature difference at zero watts load is designed for use with stud-mounted diodes and transistors. The cooler will provide cooling at any current up to 17 amp., operates at 0.3 v. and will pump 4.25 w. minimum across zero deg. C temperature difference. Cold sides of thermoelements extract from component case heat which is pumped to other side and rejected to a chassis, fins or other heat sink. Manufacturer: General Thermoelectric Corp., P.O. Box 253, Princeton, N. J.

• **Miniature magnetrons,** MA-231 and MA-232 series, designed for pulsed or cw operation, at any fixed frequency within 7.5 to 8.8 kmc. range and 8.8 to 10 kmc. range for the two series, respectively. Standard tube center frequency tolerance is ±25 mc. Magnetrons operate at duty ratios up to 0.05 without reduction of filament power and are recommended by company for applications requiring peak pulse power of 50 to 200 w. At reduced filament power, these tubes can supply 5 to 20 w. cw output. Manufacturer: Microwave Associates, Inc., Burlington, Mass.

WE SOLVE PEOPLE PROBLEMS!

We're not so good at making bits and pieces of missiles or airplanes, or electronic gizmoes or even nuts and bolts. In fact, we don't even try. BUT we are very good at building movable places to do things in like live and work. Especially for people. Because we help solve people problems. Like when your project needs lots of people and there's no place to put them. And you don't want to build a big city to leave when your project is done. You see we build mobile units. When your job is finished, you take them with you and use them again some time. We even build them to government specifications. Please write us and find out how we can help you solve your people problem.

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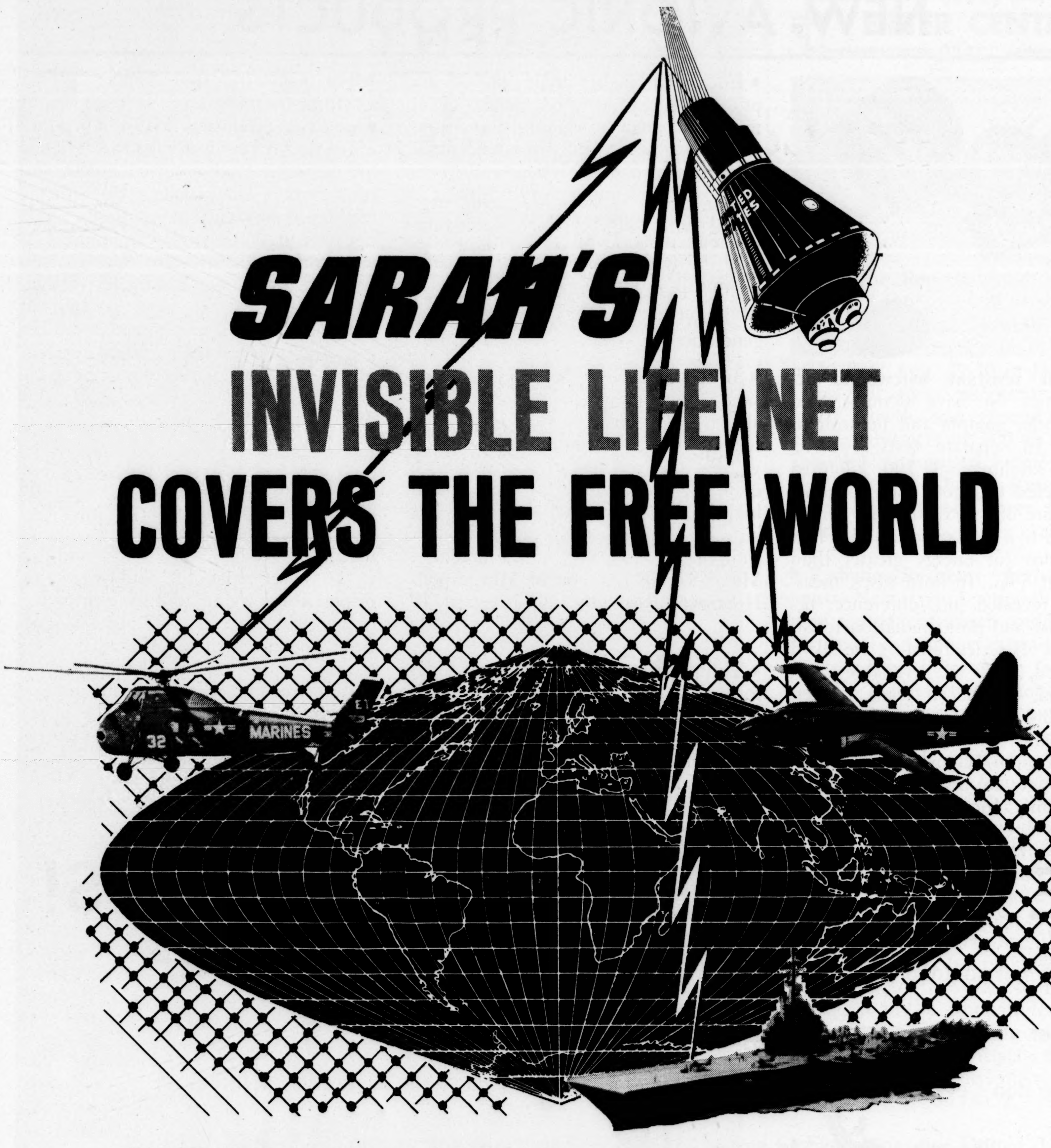
SARAH'S INVISIBLE LIFE NET COVERS THE FREE WORLD



SARAH (Search And Rescue And Homing) systems have operated successfully in every Project Mercury launching and recovery. The miniature SARAH transmitter, supplied for Mercury by Simmonds Precision Products, Inc. is actuated automatically during descent, after withstanding all environmental forces of space flight. SARAH receivers, installed in aircraft, ships and stations throughout the free world, receive the beacon signals and pinpoint location of the capsule. SARAH assures quick, safe, dependable recovery of America's astronauts!

The outstanding success of SARAH has focused increased attention on its proven capabilities in personnel location and recovery applications, for which it was originally designed. Civilian agencies and the military are increasingly using SARAH for the most effective personnel rescue operations.

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MANAGEMENT

Geophysics Corp. Expands Space Studies

By George Alexander

Rising growth curve of Geophysics Corp. of America reflects the increasing interest of both the civilian and military space agencies in atmospheric and space research.

Founded three years ago with backing from the Laurance S. Rockefeller interests, Geophysics Corp. has climbed from sales of $948,386 in 1959 to $1,918,559 in 1960 and, pending final audit, to about $3.75 million for this past year. First-year earnings were $29,411; profits more than doubled in 1960 to $63,947 and are expected to compare favorably in 1961 with the 1960 figure.

Two recent contract awards to the Bedford, Mass., firm exemplify the scope of its research work. The first, for about $100,000, is a year-long study contract from the Advanced Research Projects Agency to estimate the amount, dispersion and properties of the exhaust matter that will be spewed by Saturn and Nova launch vehicles at ionospheric altitudes and their possible consequent effects on earth-bound communications and observations, weather, climate and solar radiation.

The second award, now being negotiated with the National Aeronautics and Space Administration, calls for development and ground testing of a 20-ft.-dia. wire mesh sphere in support of Project Rebound, NASA's second-generation passive communications satellite.

Richard D. Coons, Geophysics Corp. vice president, pointed up the importance of the ARPA study by saying that the ease with which the earth's atmosphere can be modified is demonstrated by the strong glow—visible for hundreds of miles—caused by the release of less than 50-lb. of sodium atoms in the ionosphere.

Exhaust Deposit

The company's study, Coons said, will attempt to determine the rate of exhaust matter deposited by various fuel combinations, rate of dispersion and loss caused by winds and diffusion; effects of solar radiation on the matter and of the matter on solar radiation- such as reflection or absorption; interaction of the matter with the reactive gases in the ionosphere; extent to which the matter might cause scattering of sunlight or catalytic reactions and possible effects on the earth's weather, as suggested by some theories that relate rainfall with meteor showers in the upper atmosphere.

ASTRONOMICAL DOME, constructed by Geophysics Corp. scientists, is used to evaluate data gathered from tracking camera coverage of sodium cloud motion in the ionosphere.

The firm's research activities—which are the core of the company's efforts—fall into four general categories:

- **Space sciences,** which includes studies of the earth's atmosphere and ionosphere, atmospheres of the planets and meteorology of Mars and Venus. Under contract to NASA, Geophysics Corp. is constructing models of the Martian and Venusian atmospheres to assist the civilian space agency in the design of equipment that will have to function in those environments. Also for NASA, the company has launched a series of sounding rockets from Wallops Island, Va., to altitudes of 60 to 150 mi., releasing sodium clouds to indicate the effects of winds, wind shears and diffusion at those heights. Geophysics Corp. also provided the sodium payloads for similar tests conducted last year by the Italian government.
- **Nuclear weapon effects** and associated detection research, mostly for ARPA. These studies range from short-time phenomena—these effects happening less than 0.1 sec. after a nuclear explosion in the upper atmosphere—to long-term histories of the motion of the nuclear debris. The latter studies, Coons said, are of particular importance because of the increased electron density caused by debris in the upper atmosphere and consequent disruptive effect on earth-bound radar and communications systems. The company also is developing, in support of Project Vela, ground-based optical equipment that would detect the scattering of sunlight caused by nuclear debris particles. Another study deals with the effect of high-altitude nuclear explosions on infrared radiation.
- **Ballistic missile defense,** which includes studies of the possible effects natural auroral, airglow and other night emissions in the ultraviolet and infrared bands might have on defensive space systems, presumably for those systems that use these frequency bands for the identification, tracking or interception of hostile warheads of spacecraft. Geophysics Corp. also is performing laboratory experiments of the chemiluminescent (luminosity caused by chemical reaction) reactions among elements in the upper atmosphere and exhaust gases of the type generated by ballistic missiles. The firm also is constructing

TODAY'S DEFENSE SYSTEMS:

Worth more & why

In today's defense arsenal, things cost more. They cost more because they are worth more. They do jobs undreamed of a few years ago—with reliability never believed possible.

Jet fighters are flying higher and faster.

New atomic-powered ships carry enormous strike power.

Missiles are thrusting farther with greater accuracy.

And new electronic systems, like the Hughes Tactical Attack System, are making "impossible" control jobs a daily routine.

Hughes systems, developed to meet the most advanced fighter mission problems, have paced airborne systems development. They have flown with the F-86, the F-89, the F-102, the F-106, and other U. S. Air Force, U. S. Navy and Canadian aircraft.

The new Hughes Tactical Attack System in its own right achieves new levels of capability, reliability and over-all economy. Highly flexible in design, this new system will be as modern in the late 1960's as it is today. It integrates three major functions—high resolution radar, weapon control auxiliaries and a navigational subsystem. Each function incorporates the latest state-of-the-art developments.

Coolant Problems which could be encountered in aircraft flying at multiples of sonic speeds and at high altitudes have been solved. New techniques are being applied which provide for more efficient cooling of the thousands of electronic parts and assemblies, promising greater reliability.

New "encapsulation" packaging techniques permit more work to be done in smaller space, saving weight and, again, vastly increasing reliability. This technique packages complex circuits in small "blocks" of plastic material. Each contains scores of diodes, transistors, relays and other electronic components. These units are vibration-free. They can be plugged in and out as easily as a toaster—facilitating trouble-shooting and cutting maintenance time.

These kinds of advancements are the "norm" at Hughes. For they are the result of over 16 years of prime experience in the design and building of airborne systems. The new Hughes Tactical Attack System has grown out of a special, company-funded program which has been active for three years.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY

An important part of Hughes airborne systems capability is the company's background in field service and support functions. This work, involving seven major systems, helped in the development of the unique self-test features incorporated in the new Hughes Tactical Attack System.

Better today, better tomorrow. The Hughes Tactical Attack System, like other major new defense systems, is worth more simply because it delivers more—in actual hardware capability *and* in the skills and facilities that back its success.

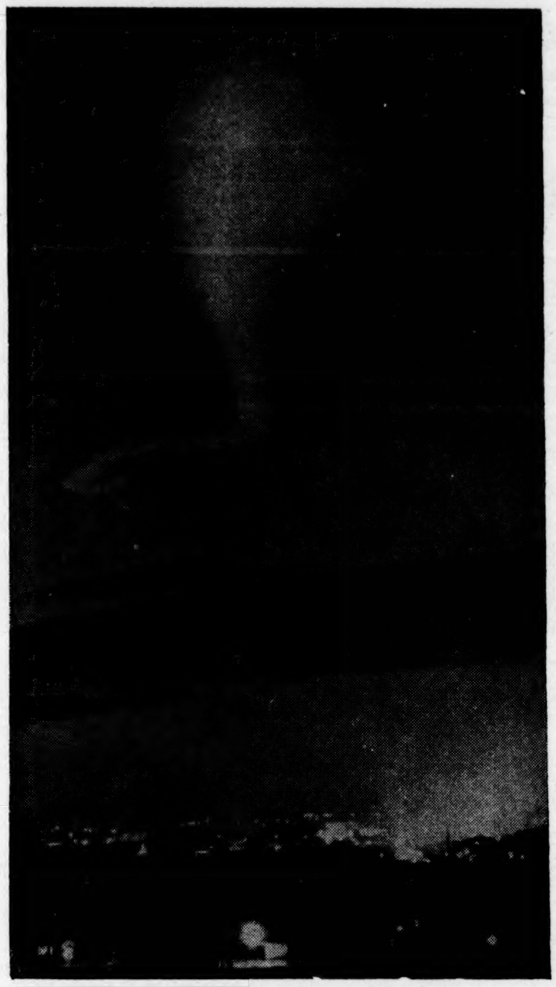
(1) Hughes Tactical Attack System has all the features and technical advancements necessary to the mission.

(2) Hughes has one of the Free World's most efficient electronics manufacturing capabilities.

(3) Hughes engineers draw on experience gained in the design of systems for more aircraft than any other group.

(4) Hughes Field Engineers have worked with more than 16,000 airborne control systems.

(5) The Hughes system will not become obsolete before it flies. Rather, it is presently designed to keep step with improved aircraft performance and more demanding mission requirements.



SODIUM VAPOR CLOUD, released in two injections at altitudes of 120 and 228 mi. from the 145-lb. payload of a four-stage Argo launch vehicle, leaves a serpentine trail. Ground equipment monitored the cloud's movement to measure velocities, temperatures and densities of atmospheric winds at high altitudes.

hypothetical models of the physical properties of shock waves and the trails of gaseous and solid particles caused by missiles during powered flight. Discrimination of a hostile ballistic missile warhead among decoys is still another company project and Coons said that the Geophysics Corp. proposal to conduct experimental work on this classified technique is being actively considered by the Defense Department.

- **Inflatable vehicles** for use both in the upper atmosphere and space. Coons said that the company is building "several interesting new structures to serve as penetration aids and as vehicles which can be used to study the density and winds in the atmosphere ranging from 20 to 60 mi." The NASA contract for an inflatable rigid passive communications sphere will allow the firm to investigate its approach to the problem of a balloon that is sufficiently rigid to maintain its shape for optimum signal reflection, but still light in weight. Geophysics Corp. plans to insert a standard balloon within a wire mesh bag with the comparative stiffness of chicken wire. Inflation of the balloon, once in orbit, would extend the wire mesh into a sphere and the balloon then could be either deflated or allowed to be punctured by cosmic dust particles. Spacing between the mesh will be approximately 3 mm., reflecting microwave signals of 3 cm. wavelength.

In other projects, Geophysics Corp. is investigating the possibility of chemical modification of the atmospheres of other planets, so as to make them similar to that of the earth and perhaps capable of sustaining life. To provide continuous electrical power for spacecraft during day and night, the company is looking into the feasibility of an ionospheric battery. Admitting that the practicality of the concept remains to be proved, the firm says that in principle a space vehicle should be able to extend plates of two dissimilar metals into the ionization that exists in the ionosphere and draw a current of about 2 microamp./cm^2 at an altitude of approximately 215 mi. Potential would be about 1 volt. Coons said plates would have to be "of fairly large size" to draw a usable current.

Geophysics Corp., with Milton Greenberg as president, employs about 325 personnel and has four divisions:

- **Physics Research,** where the atmospheric, nuclear detection and ballistic missile defense work is carried on.
- **Daniel W. Mann Co.,** Lincoln, Mass., produces precision measuring instruments, optical comparators, photo repeaters, lens test benches, reduction cameras and camera calibrators.
- **Vacuum Specialties, Inc.,** Somerville, Mass., acquired in April, manufactures high vacuum processing equipment.
- **Viron,** Anoka, Minn., manufactures research balloons and fabricates most of the company's inflatable structures.

Ford Takes Control Of Philco in Merger

Philadelphia—Ford Motor Co. has assumed control of Philco Corp. with the purchase of Philco's assets for approximately $100 million in Ford stock.

The acquisition extends Ford's activities into the household consumer, computer and transistor markets, and reinforces the company's position in the military electronics market.

President of the new Philco Corp. is Charles E. Beck, formerly director of Ford's business planning office. Beck replaces James M. Skinner Jr., who stepped down from the Philco presidency Dec. 7. Board of directors of the new corporation is composed entirely of Ford management. Elected officials are predominantly former Philco management personnel.

Beck stated that Philco will be operated as an "autonomous subsidiary" of Ford. Major factors behind the acquisition were Philco's potential for expansion and growth, he said. Ford is particularly optimistic about prospects for Philco's government and industrial group which has handled many major avionics programs.

BUSINESS FLYING

Beech Aims at Widening Market Potential

By Erwin J. Bulban

Wichita, Kan.—Refinements in the 1962 line of Beech Aircraft Corp. business airplanes, planned at minimizing price increases, will be a major factor in the company's marketing program in the year ahead.

Beech estimates that commercial business in Fiscal 1962 probably will be 15% higher than Fiscal 1961 when company business reached approximately $43 million, including spares and accessories.

To further broaden its market potential, the company's wholly owned finance subsidiary has liberalized distributor-dealer floor planning and financing programs, providing a substantial decrease in the cash outlay required by sales outlets at the time of purchase of demonstrators. Cash requirement has been cut in half, a company executive noted.

Beech also is pushing its programs of adding retail outlets to the current domestic line-up of about 115. A recently completed survey indicates that there is a potential for 188 retail outlets in the U. S. capable of handling single-engine aircraft sales profitably.

Although a key feature of the meeting here of a group of Beech distributors was introduction of the company's new $12,000, four-place Musketeer (AW Dec. 4, p. 94), it was emphasized that this airplane will not be ready for deliveries until early fall of 1962, and therefore would have little or no effect upon Fiscal 1962 sales volume. Major attention was given the company's standard line—primarily, introduction of the new Model P35 Bonanza and A55 Baron light-twin in advance of introducing these airplanes into the field for detailed demonstration at retail sales outlets across the country.

New policy of spreading out introduction of new models and providing in-the-field introductions, rather than a simultaneous unveiling of an entire line, was inaugurated by the company this year (AW Oct. 23, p. 102).

Regional Introduction

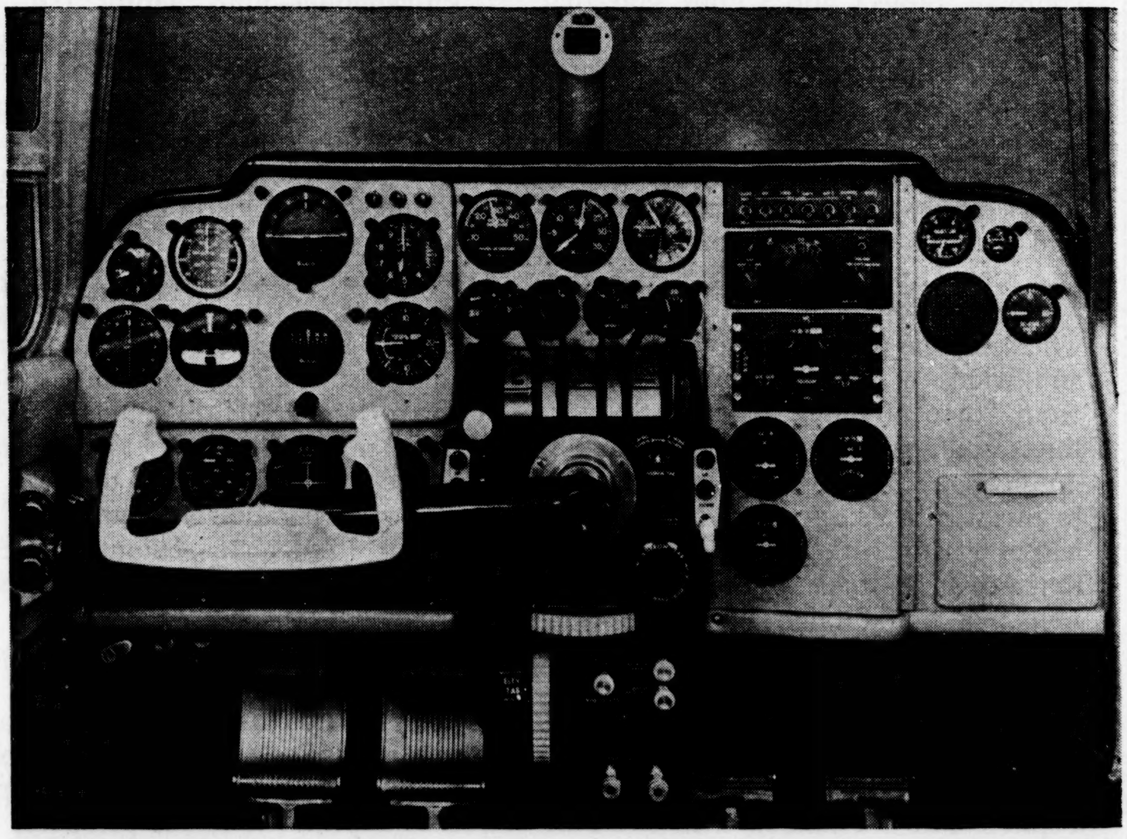
In-the-field regional introduction of the Bonanza and Baron this month follows a similar program utilized with the 1962 Queen Air and Debonair in October. New Bonanza and Baron will be presented at distributor facilities in six cities by two factory teams starting Dec. 11 and ending Dec. 18. Vice President-Marketing Wyman L. Henry will head the factory personnel covering the eastern portion of the country and Vice President-Domestic Sales Leddy L. Greever will be in charge of the western team. Customer prospects for the airplanes also will be invited to observe the Bonanza and Baron during their visits to the distributors.

- **P35 Bonanza** features interior restyling, with efforts to improve passenger comfort centered around completely new, contour-type passenger seats having infinitely-variable-position backs. Instrument panel also has been revised to incorporate T-mounting of the flight group on a separate, removable shock-mounted panel. Radio equipment, positioned on the right, is canted toward the pilot for easier handling. Engine group now incorporates a combined manifold and fuel pressure gage to simplify computations. Price is up approximately 1% from last year's model (see box, p. 97).
- **A55 Baron,** which has been one of the major moneymakers in the line since its introduction last year—production flow rates being adjusted upward three times in 1961—this year is being offered with an optional version. New rear two-place seat can be folded and stowed when not being used. Other Baron improvements include capability of extending landing gear and depressing flaps 15 deg. at 175 mph. indicated, an increase of 15 mph. for this configuration, which is aimed at easing traffic pattern handling. Propeller tips are rounded to reduce noise level.

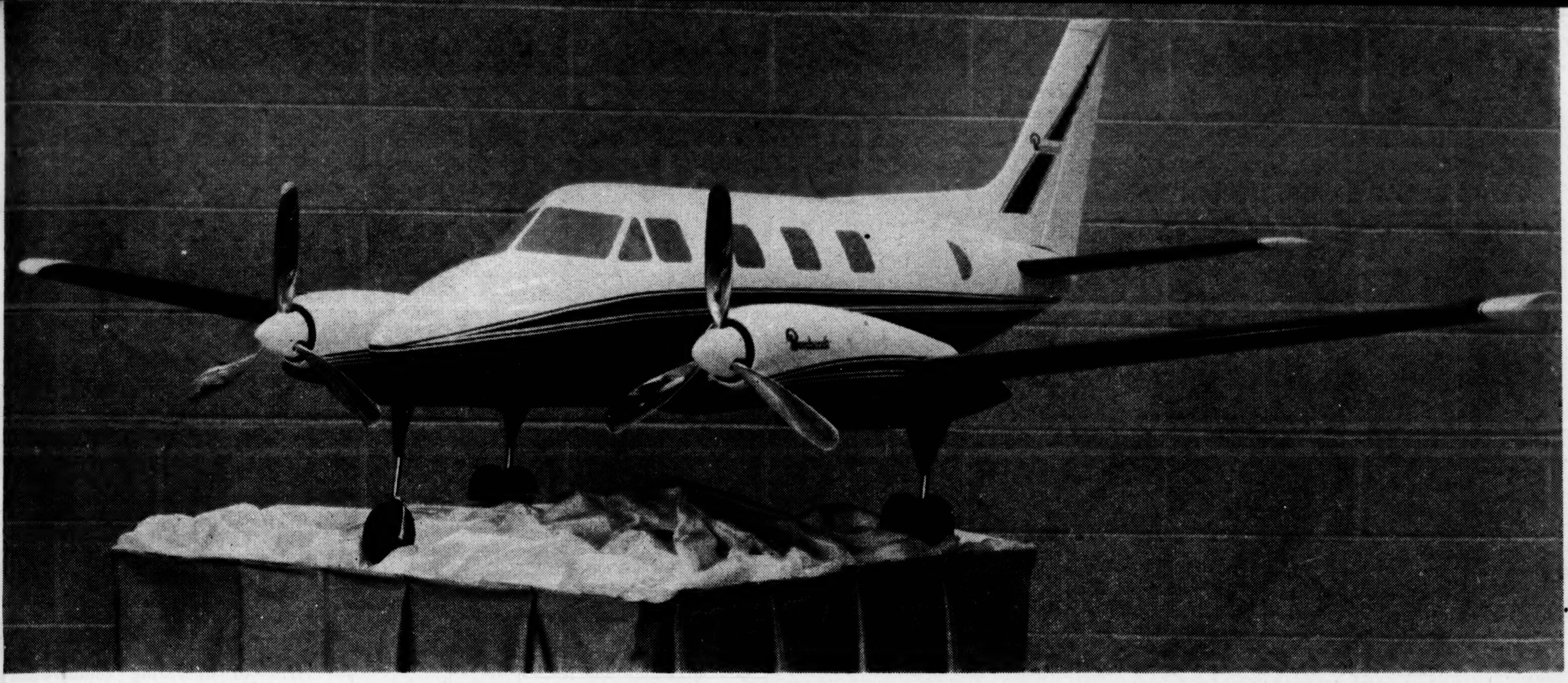
Market Opportunities

Market opportunities for the company's 1962 line, detailed by Greever, provided a breakdown by category, in which Beech line increased sales will be attempted:

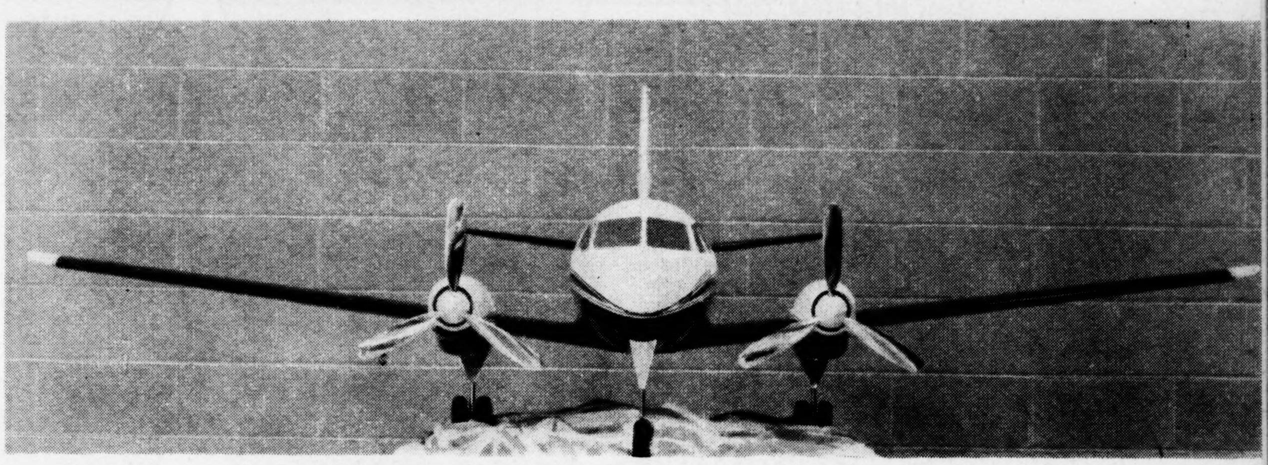
- **Bonanza and Debonair** are keyed to a total domestic market for this class airplane averaging more than $31 million per year, in competition with Cessna's 210 and Piper's Comanche 250. According to Greever, Beech Aircraft's past coverage has been about 42% of this volume and he expects that the company should participate to the extent of at least 50% of this business. Beech marketing studies, based on 1960 data, show that 50% (200 units) of sales of Bonanzas were made to previous owners of this airplane, 20% (80 units) were sold to owners of competitive makes and 30% (120 units) were sold by the company to previous non-owners of aircraft.
- **Travel Air and Baron** light-twin class airplanes operate in a market totaling $35 million annually and include as competition, the Cessna 310 and Skyknight, Piper Apache and Aztec, Greever noted. In this market, Beech participation has been an average of 27.2% over the last two years, he said.
- **Twin-Bonanza** medium-twin, which

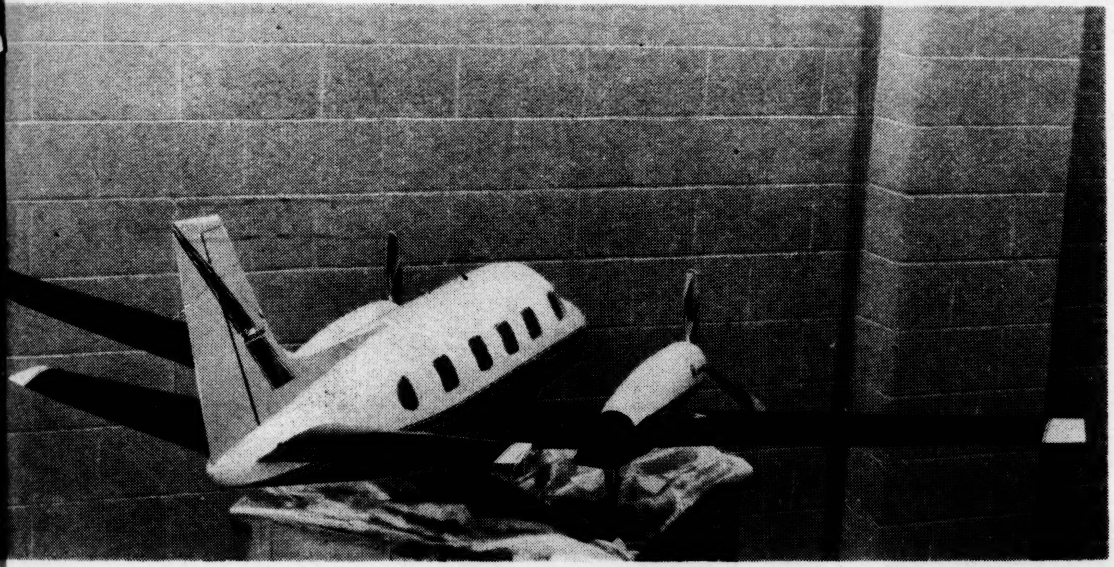


BARON INSTRUMENT LAYOUT has radio gear (right) canted six degrees toward pilot to facilitate handling. The glare shield atop the panel is thinner to improve visibility. Panel has fuel tank selector system incorporating easy-to-follow diagram. Sperry or Tactair autopilots are optional equipment in the Beech Baron.

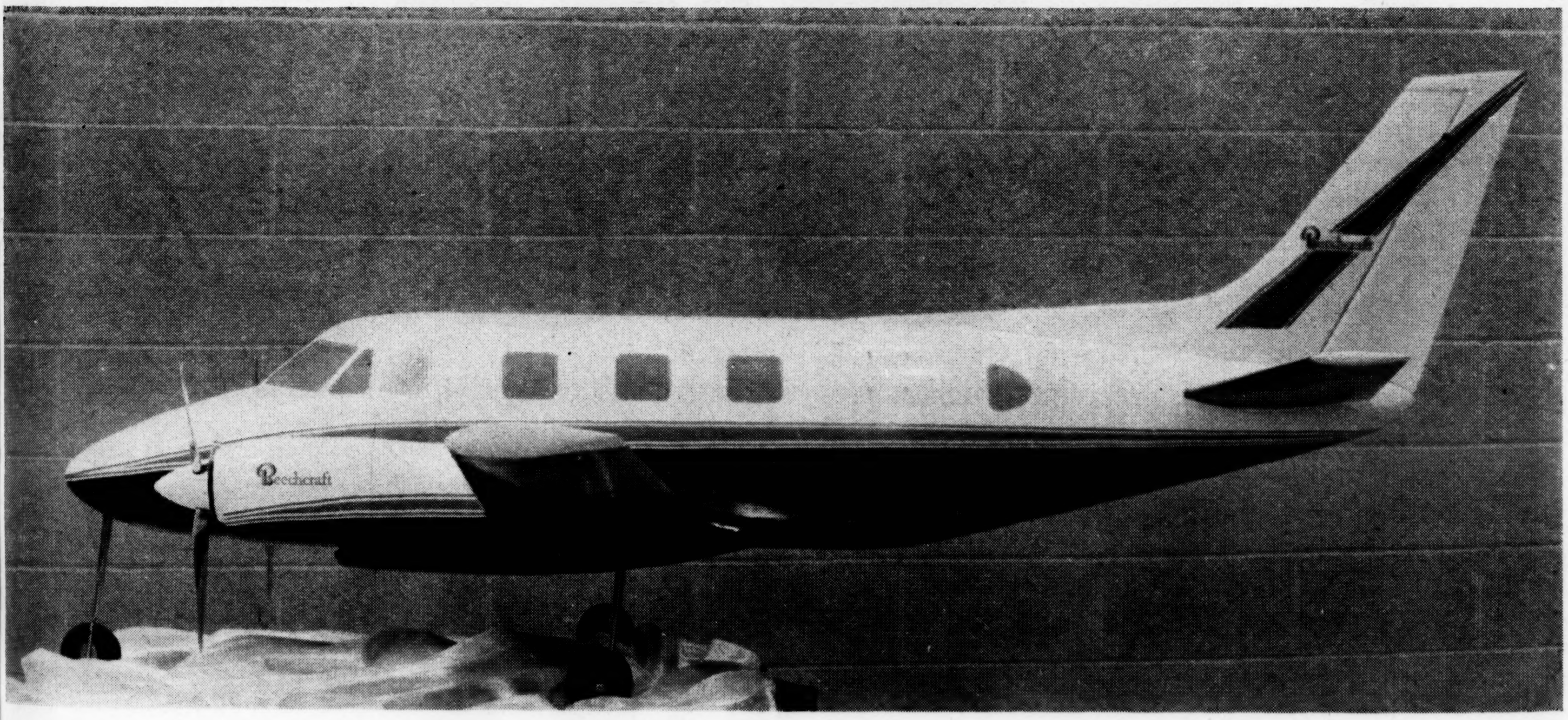


WIND TUNNEL TESTS recently completed on a model of the proposed Beech Aircraft Corp. turboprop-powered executive transport confirm original engineering calculations, according to Beech Executive Vice President Frank E. Hedrick (AW Dec. 11, p. 28). Details of the airplane still are being withheld pending analysis of data accumulated during the model testing program at the University of Washington. The aircraft will have a gross weight of about 12,500 lb., and cruise at more than 300 mph. at 25,000 ft., according to Beech.





DECISION to use the turboprop powerplant rather than the pure jet was based on an evaluation of all types of turbine engines conducted by Beech. The survey indicated the propeller-turbine combination would permit building an aircraft of the size envisaged by Beech for approximately 50% less than any of the pure-jet types now available for delivery. Beech estimates that its turboprop configuration will be brought out at a basic price of $400,000 and in fully equipped condition, with all electronics, including radar, for about $500,000. Sources close to the Beech project revealed that the 1,000-shp. French Turbomeca Bastan 4 was the leading powerplant contender at present.



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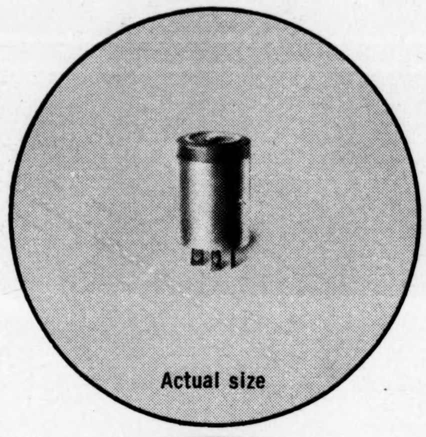
QUALITY ELECTRO/THERMAL CONTROLS

HIGH RELIABILITY FOR ELECTRONIC, RADAR AND RADIO EQUIPMENT; GROUND SUPPORT EQUIPMENT, AEROSPACE APPLICATIONS

NEW AT1-1 SUBMINIATURE PRECISION SWITCH

With a 0.440″ height, 0.320″ diam., KLIXON AT1-1 is a SPDT hermetically sealed snap-action switch. Weight: 1 gram. Shock resistant to 100 g's. Vibration resistant to 40 g's, 0-2000 cps. Current capacity: 3 amps, resistive 28 V-dc. Environmental free — complete seal assured even at high altitudes. Operates up to 275°F. Meets MIL-S-8484A, Class A.



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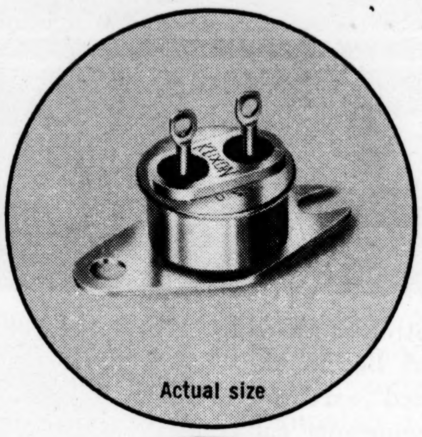


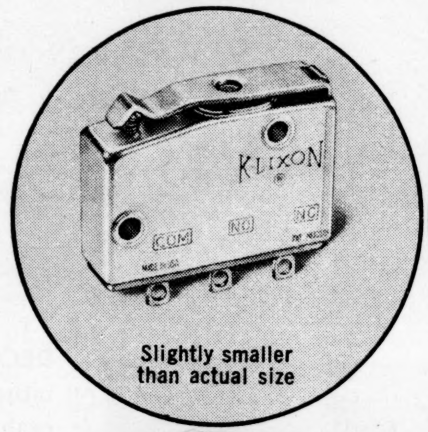
Actual size

HIGH RELIABILITY M1 PRECISION THERMOSTAT

Hermetically sealed SPST thermostat conforms with MIL-E-5272C and MIL-T-5574A. Snap-acting, disc type design for temperature control or warning on electronic and radar equipment, gyros, fuel pumps, servomotors, telemetering, de-icing and other equipment in critical avionic and aerospace applications. Vibration resistant right to operating temperature. Ambient temperature range —65° to +450°F. Minimum differential, 9°F. Ratings up to 7 amps, 30 V-ac/dc; 6 amps, 125 V-ac; 3 amps, 250 V-ac. Weight 3.7 gr basic unit.

KX-5 SERIES PRECISION SWITCHES

Hermetically sealed snap-acting limit switches. Seal uses metalized ceramic terminal inserts and metal diaphragm. Switching element, one-piece sine blade. Steel case withstands high impact and compression loads. High temperature resistance to 375°F. Vibration resistance to 25 g's, 0-2500 cps. Ratings to 10 amps, 115 V-ac or 30 V-dc resistive. 25,000 cycles minimum life. Ambient temperature range, —65° to +375°F. Weight 1 oz. Variety of actuators available.



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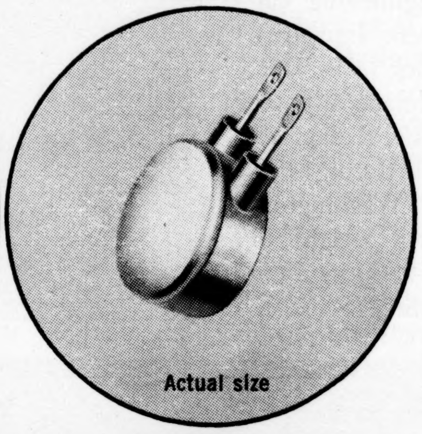


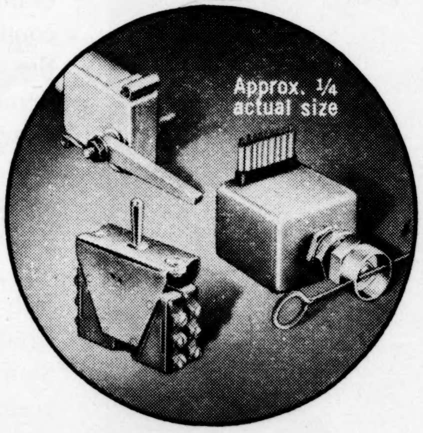
Actual size

NEW NARROW DIFFERENTIAL M2 PRECISION THERMOSTAT

Hermetically sealed SPST thermostat with positive snap action. Designed with a low silhouette, controls temperatures to narrow differentials. For use on electronic and military applications such as gyros, missiles, radar and other aerospace equipment. Ambient temperature range of —65° to +450°F, minimum differential of 2 to 5°F. Rating up to 2 amps, 30 V-ac and 125 V-ac for 250,000 cycles. Weight of basic thermostat: 3.76 grams.

PACKAGED PRECISION SWITCHES

KX and AT series hermetically sealed switches are used as basic units to build packages to meet customers' design needs. These "specials" include unique mounting configurations, connectors, leads, actuators, ganging of basic units, potting, etc. Environment free, metal-to-metal, glass-to-metal sealed. Qualified under MIL-S-6743, MIL-E-5272A, AN3234. The KX4 series has been assigned MS24456 (USAF).



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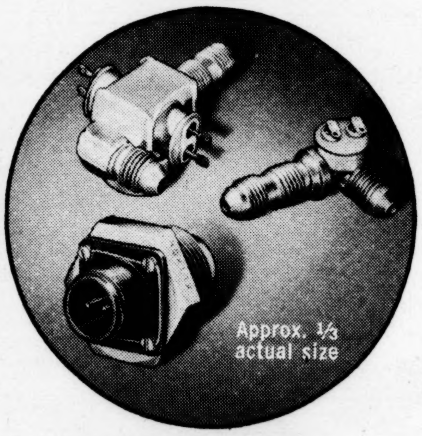


Approx. ⅓ actual size

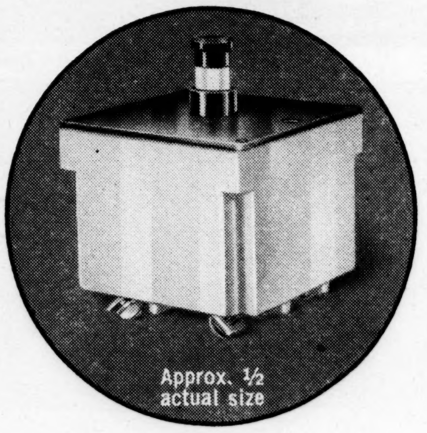
PACKAGED PRECISION THERMOSTATS

Custom designed thermostat packaging to meet special requirements based on KLIXON hermetically sealed M1 thermostats (see above). The special KLIXON Packaging Facility comprises a 3-part "hurry-up team" of designers, production specialists and testing personnel who will assign a part number at once and then meet exceptionally fast delivery requirements.

SMALL LOW AMPERAGE 7274 CIRCUIT BREAKER

Simple push-pull, trip-free design. Available as shown: DPST with solder auxiliary terminals and either screw or solder main terminals. Also, SPST with screw-type terminals. All models neck mounted. Neck bushing length 0.359″ to accommodate 0.125″ panels. Exceptionally small — depth of breaker behind panel, 1.420″ max; height, 0.750″; width 0.562″. Ratings ½ to 5 amps. Ultimate trip @ 77°F, 115-145%. 200% trip, 2-20 seconds. Vibration resistance 10 g's to 2000 cps. Shock resistance 35 g's. Weight only 0.9 oz. Also available in three-phase type.

Approx. ½ actual size



Approx. ½ actual size

THREE-PHASE D6760 SIMULTRIP* CIRCUIT BREAKER

Thermal type. Interrupts high ac short circuits . . . trips quickly . . . provides simultaneous tripping and trip-free action of all three phases should any one phase become overloaded. Phases can be different ratings. Ratings 5 to 60 amps. 120/208 V-ac, 60/400 cycle systems and 220/440 V-ac, 60/400 cycle systems. Weight 227 grams. Ac rupture capacity 2500 amps, 1ϕ, 120 V-ac, 400 cps. Ultimate trip @ 77°F, 105-138%. 200% trip, 10-70 seconds. D6760-1 is the MS21984 circuit breaker.

*Trademark of Metals & Controls Inc.

KLIXON circuit breakers, precision switches, precision thermostats and thermal protectors are small in size and light in weight; they respond quickly and with accurate repeat performance; they have ample capacity to handle a wide range of electrical loads; their calibrations stand up in the face of severe environmental conditions.

Include a KLIXON field engineer in your early design discussions. For immediate information or assistance, call or write:

METALS & CONTROLS INC.
2812 FOREST ST • ATTLEBORO, MASS
A CORPORATE DIVISION OF
TEXAS INSTRUMENTS
INCORPORATED

Greever stated is in competition with the Aero Commander 500 and 560 series, has had a total market in the United States averaging approximately $13.5 million annually in the past two years—retail sales of new 1960 and 1961 models of the Twin-Bonanza in the past year exceeded $4 million.

- **Model 65 Queen Air** and Super 18, which have competeted with the Aero Commander 680 and 720 for a total domestic market shared by these airplanes exceeding $46.5 million in the last two years, garnered over 68% of this business, Greever asserted.

Greever pointed out to the attending distributors that the field inventory situation, both distributors' and dealers', now is such that sales outlets should be better able to emphasize new models in 1962 than in past years. As of November there were 69 1961 Debonairs in field inventories, according to Greever, compared with 95 a year ago. Bonanza inventory was 77 airplanes as against 103 a year ago, Travel Air stocks totaled 26 as against 45 last year, Twin-Bonanza field inventories of 1961 models totaled 11 as against 24 a year ago, Super 18s totaled 19 in November as against 24 last year, 1961 Queen Air stocks are down to 20 airplanes compared with 25 last year. Of the 191 Baron light twins delivered by the factory during its first year, there are only 38 remaining in the field, according to Greever.

Future Business

Regarding future business, Market Research Manager Henry Ryan told listeners here the company's studies indicate a firm business airplane market in the United States of 390,000 prospects for one or more airplanes. Ryan said this total market consists of 330,-

Beech Prices

Wichita, Kan.—"Hold-the-line" attitude is reflected in pricing of most of Beech Aircraft Corp.'s line of 1962 business airplanes. Prices of basic airplanes, with standard equipment, are:

- **Model G18S Twin-Beech—$132,300, same as 1961.**
- **Model 33 Debonair—$21,975, compared with $21,750 last year.**
- **Model P35 Bonanza—$26,875, compared with $26,500 for 1961.**
- **Model D50E Twin-Bonanza—$87,250, same as 1961.**
- **Model J50 Twin-Bonanza—$100,000, same as last year.**
- **Model A55 Baron—$58,950, compared with $58,250 last year.**
- **Model 65 Queen Air—$126,000, same as in 1961.**
- **Model B95A Travel Air—$49,500, down from last year's $51,500.**

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PROBLEMATICAL RECREATIONS 97

An engineer must test three space suits in two test chambers. Each suit must be tested for 1 hour at each of two low pressures. He takes ten min. to load a suit in a chamber, set the pressure, and start the test; 4 min. to change the pressure, and ten min. to unload a suit from a chamber. What is the minimum time to complete the tests? —*Contributed*

Rapidity is a particularly important feature of the seriograph equipment from our (who else!) Automatic Seriograph Corporation in Maryland. Twelve 11"x14" X-Ray photographs can be made in rapid succession for the study of the body's circulatory processes. They've just come up with a new model of exceptional durability and convenience of operation.

ANSWER TO LAST WEEK'S PROBLEM: Gwen loves Alan.

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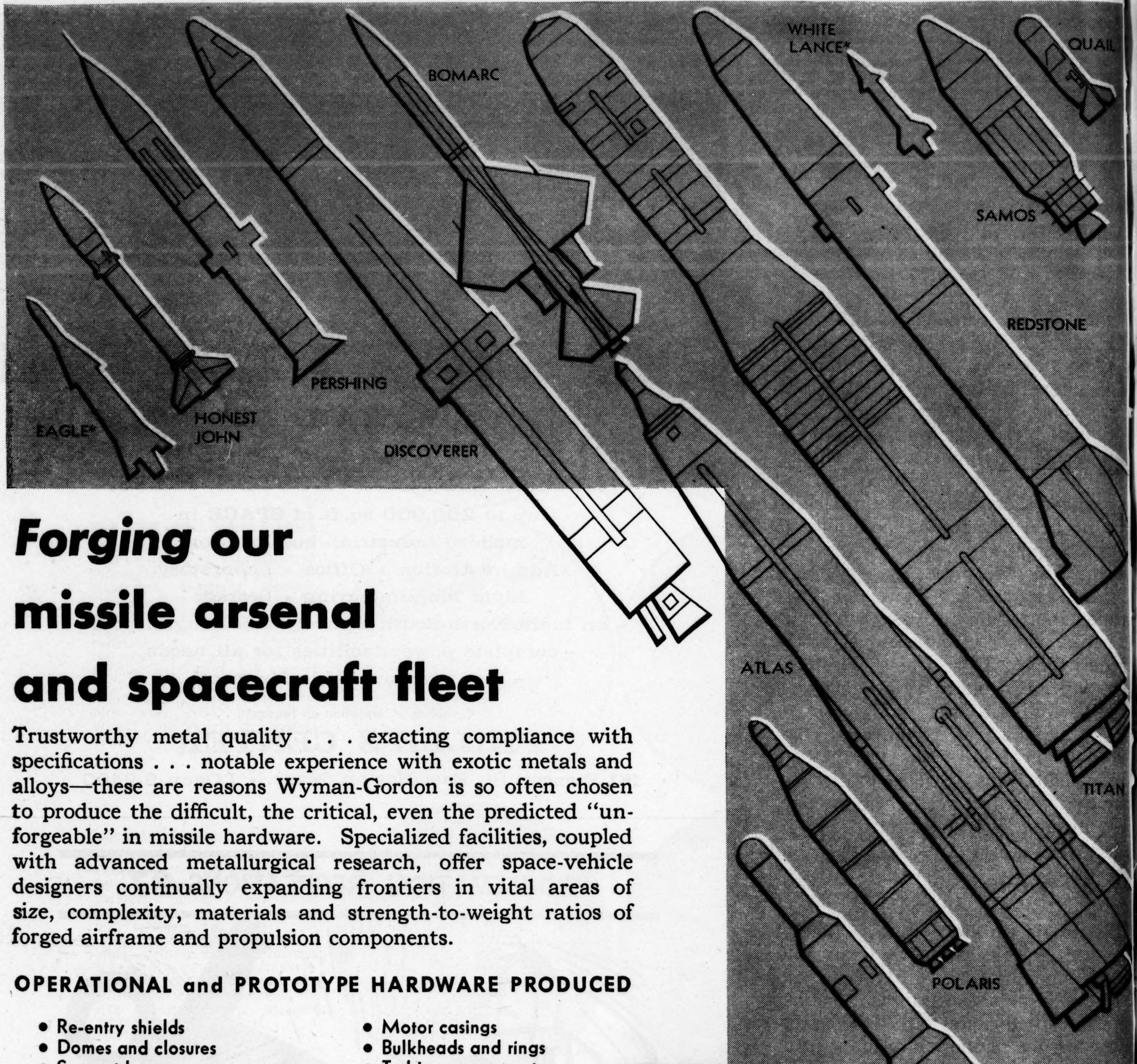
Beverly Hills, California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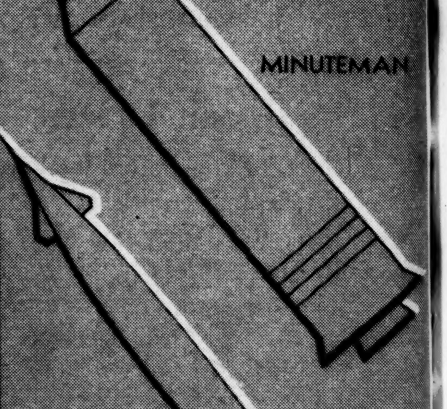
ATLAS
TITAN
POLARIS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- Turbine components
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- Guidance components
- Ground support equipment

WYMAN - GORDON

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of Aluminum Magnesium Steel Titanium . . . and Beryllium Molybdenum Columbium and other uncommon materials

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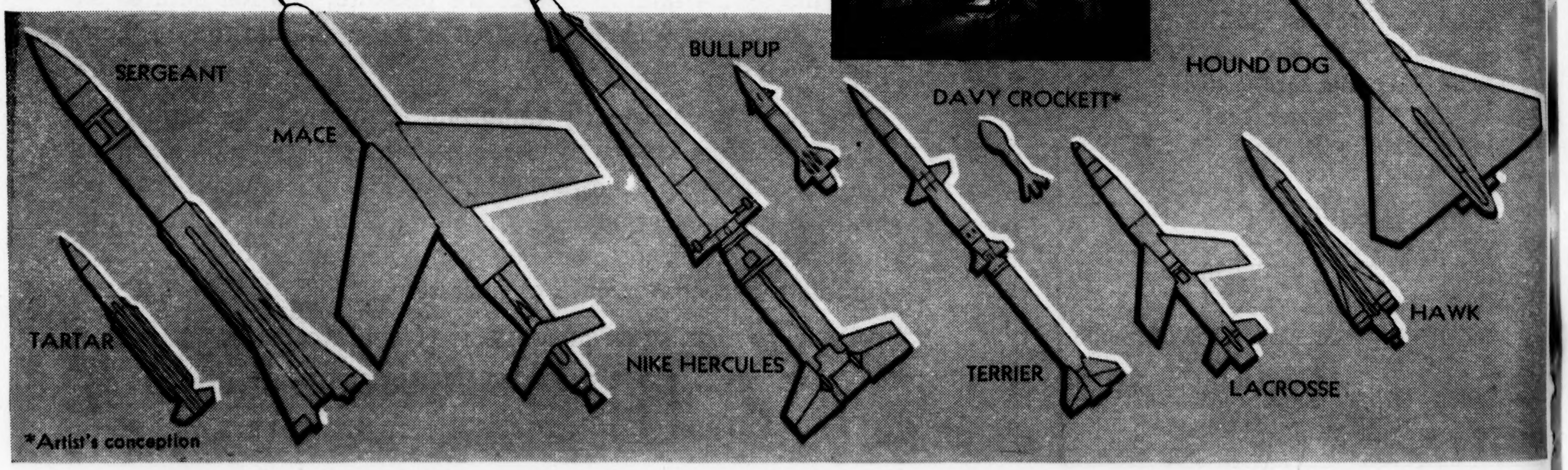

SERGEANT
MACE
BULLPUP
DAVY CROCKETT*
TARTAR
NIKE HERCULES
TERRIER
LACROSSE
HAWK
*Artist's conception

000 prospects for single-engine equipment, 100,000 for light twins and 60,000 for medium twin class.

This data was developed from a detailed study of the total number of U. S. companies. Then firms which have no need for airplanes or ability to buy them were winnowed out. Buying patterns of airplane users were then studied as well as traveling patterns of business travelers and the local degree of airplane acceptance all over the country so that these factors could be applied against the potential that was weeded from the over-all total to test validity of final prospect breakdown.

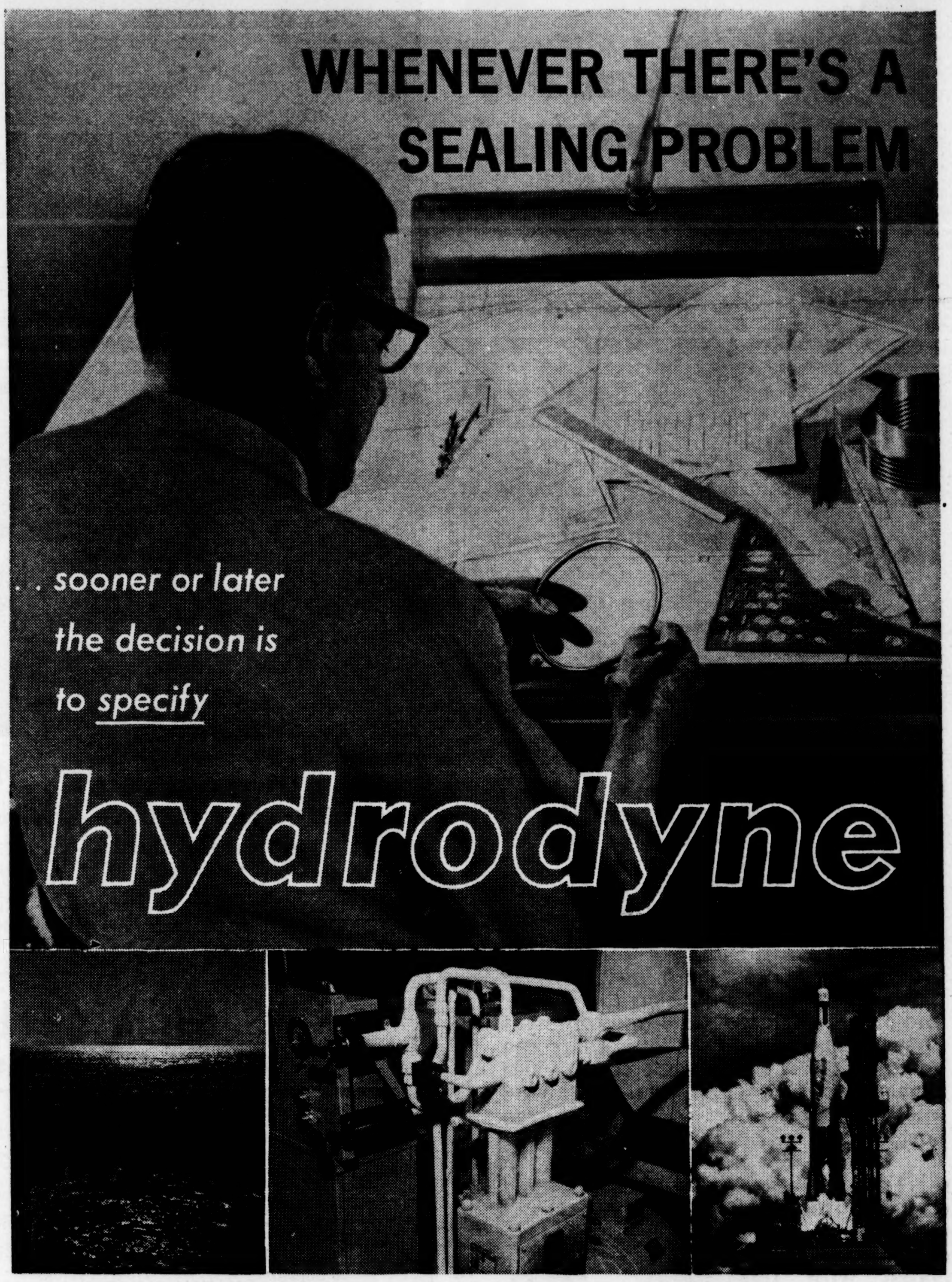
Beech export operations last year totaled nearly $12 million—a gain of 31.5% over the foreign sales team's 1960 effort, which in turn had represented a 108% increase over 1959. Buildup in foreign sales by Export Sales Vice President Michael Neuburger's overseas distributor-dealer organization achieved more than 14% of Beech Aircraft's total volume last year, as compared with 8% in 1960.

Neuburger indicated that the European Common Market can be expected to have a highly significant influence on future sales of business airplanes abroad because in time it will comprise a group that will be equal in economic strength to the United States and surpass the Soviet bloc, and he expects that the purchasing power this market will represent will more than offset any import restrictions that may be imposed on American products. Eventually, he noted, the U. S. may, in some form, become associated with the Common Market and other international trade groups.

Beech also reported that the Japanese navy has decided to buy three Queen Airs. Beech anticipates that this purchase will be the first of orders by the Japanese navy for approximately 50 airplanes over the next five years. In line with military sales, the U. S. Army is planning to buy 44 military versions of the Queen Air (L-23F) with production extending over the next two years. These contracts are expected to hold the price down on future Queen Airs.

Two-Place Beech

Two-place private plane has been under study by Beech, and this probably will be a revised version of its new four-place Model 23 Musketeer. Four-place Musketeer, unveiled at Beech's distributors meeting, is to be marketed in early fall of 1962 (not early fall of 1963, as inadvertently reported in Aviation Week Dec. 4, p. 94). Two-place version of the Musketeer probably will have a lower-powered engine in the 100-hp.-class, instead of the four-place model's 160-hp. Lycoming.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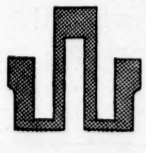
Hydrodyne standard seals are available in sizes from ¼" to 30". Custom types, including nonmetallic coatings and exotic materials, also available. Write for details.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Because of the exclusive patented configuration, Hydrodyne seals — regardless of pressure or temperature — always hold a positive spring-tight flat metal surface against the mating surface. Never an angle or an edge.

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PUMP PRIMERS
ARTHUR A. NICHOLS

VALUE ANALYSIS REPORT ON GEROTOR PUMPS

► The rather unusual qualities of the Gerotor pump which have kept it intimately associated with aircraft pumping applications from the days of the earliest superchargers for reciprocating engines, can best be summed up as *inherent adaptability* and *high reliability.*

► **The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance at high altitudes and has low wear over a long service life. In addition, it is balanced and extremely quiet in operation.**

► Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See Fig. 1.)

► **Valveless design insures absence of mechanical troubles associated with the operating complexity and service and wear problems inherent in valve construction.**

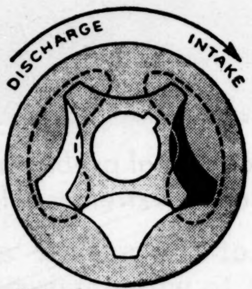

FIG. 1

► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

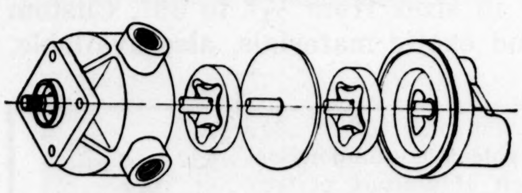

Fig. 2. Several fluid systems can be served economically by one multiple element pump arranged as shown in diagram.

► *Technical data is available and your inquiry is invited. Write:*

W. H. NICHOLS CO.
Makers of Zenith Metering Pumps
and the Nichols Milling Machine
"the miller that uses its head".

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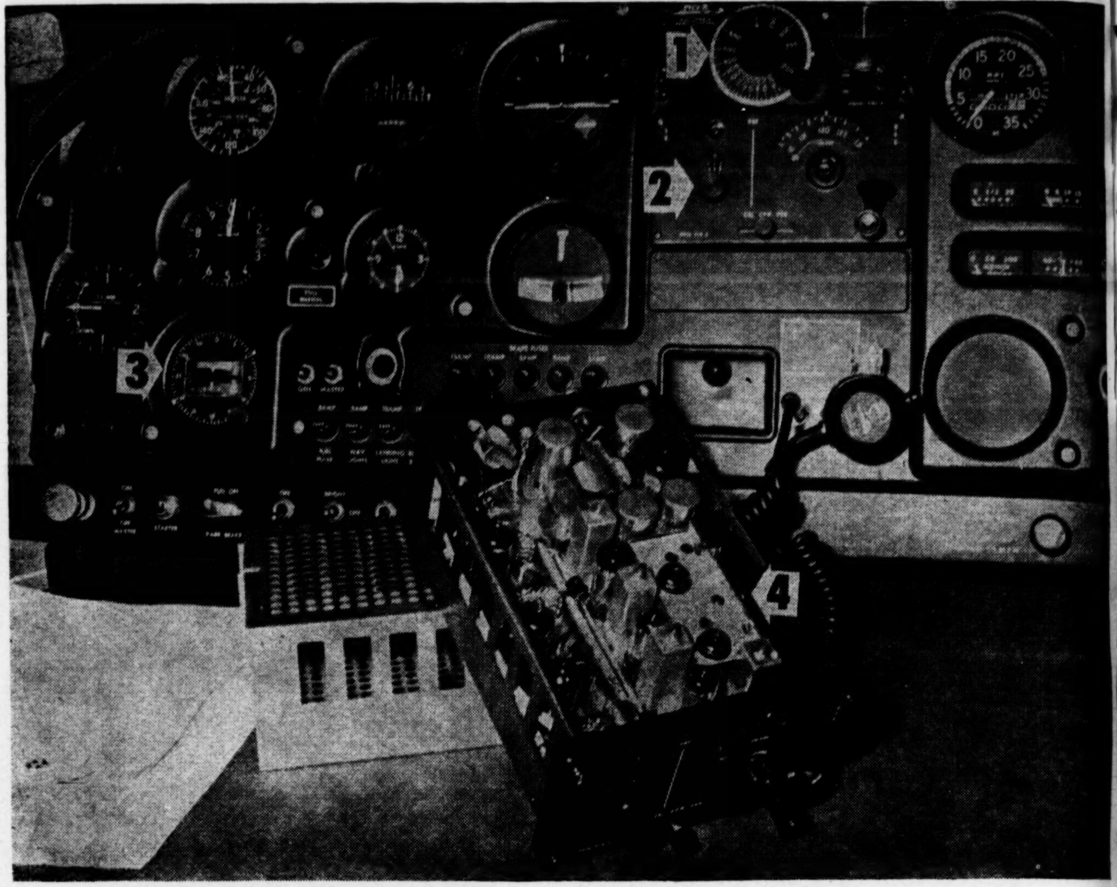


Piper Installing Its Avionics in Cherokee

Inroads that Piper's Electronics Division is making in competition with former vendor-supplied equipment is pointed up in this view of Piper Cherokee instrument panel, showing Piper AutoNav (1), a simplified direction finder selling for $400 installed, and the new PTR-1 transceiver (2) which will be available in a few months for about $600 installed. PTR-1 omni indicator is at left (3). PTR-1 is in foreground with case removed (4).

U.S. Business & Utility Plane Shipments

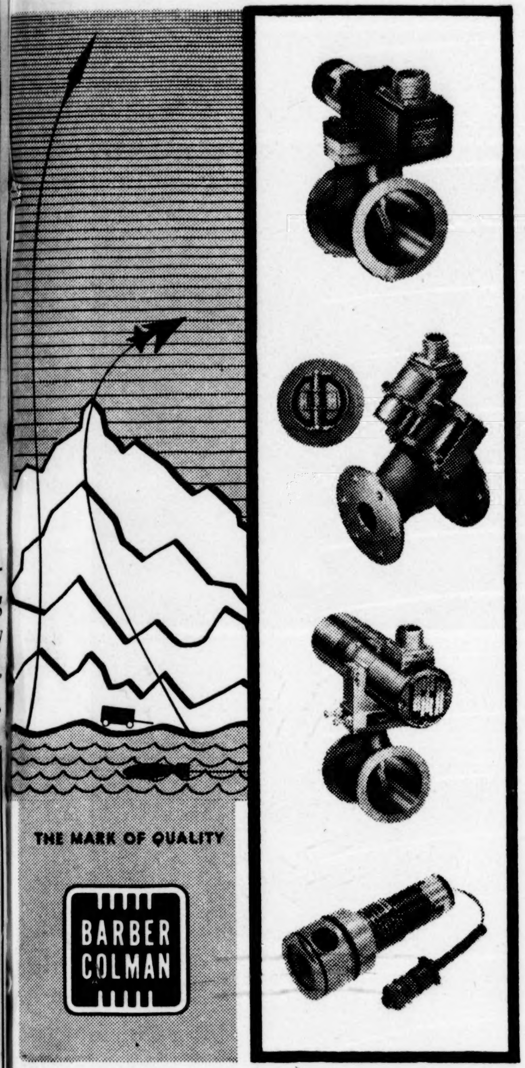
September 1961

Make & Model	No. of Units	Factory Billings
Aero Commander 500A, E	9	$1,536,000
560F	5	
680E, F	4	
Beech 18 Super	4	$2,950,000
33 Debonair	2	
35 Bonanza	15	
50 Twin-Bonanza	1	
55 Baron	12	
65 Queen Air	9	
95 Travel Air	5	
Callair A-5	1	$7,000
Cessna 150	9	$2,383,000
172, Skyhawk	18	
175, Skylark	8	
180	3	
182, Skylane	39	
185 Skywagon	18	
210	13	
310F	4	
Champion 7EC Traveler	2	$43,000
7FC Tri-Traveler	3	
7GCB Challenger	1	
7HC DX'er	1	
Lake LA-4 Skimmer	1	$23,000
Mooney Mark 21	34	$606,000
Piper PA-18-150 Super Cub	15	$1,931,000
PA-22-108 Colt	126	
PA-23-160 Apache	2	
PA-23-250 Aztec	11	
PA-24-180 Comanche	3	
PA-24-250 Comanche	15	
PA-25-150 Pawnee	19	
PA-28-150 Cherokee	5	
PA-28-160 Cherokee	26	
Totals	443	$9,479,000

Note: Total shipments for the first nine months of Calendar 1961 were 5,029 aircraft having a total net factory billing value of $93,948,000, compared to 5,658 airplanes having a total billing value of $114,676,000 for the same period last year. Actually, shipments and dollar volumes in the last three months of the current year compare very favorably with those of the same period in 1960, the number of airplanes delivered being higher in July, August and September than during these months last year and dollar volumes, somewhat lower, being very comparable, indicating a return of optimism following the depressed period developing as a result of the recession. Industry observers expect that this upturn will continue and that 1961 will be a very good year for business flying manufacturers. Deliveries of the Piper Colt continued at a high rate; as of September, this manufacturer delivered 1,008 of its two-place "compacts," nearly five times the number of two-place Cessna 150s in the same period.

Valves for
all types of
space*
applications

*INNER, OUTER, IN-BETWEEN
. . . EVEN UNDER!



Whether your application is for outer space, at aircraft levels, on land, or undersea, the chances are good that Barber-Colman can design the exact valve to meet your needs.

Shown above are typical Barber-Colman valves used on missiles, aircraft, ground-support equipment, and torpedoes.

The full line of Barber-Colman valves includes motor-operated butterfly; poppet, sliding port, and check types—either in standard sizes or special sizes and adaptations to fit your own requirements.

For complete details write for bulletins, or consult the nearest Barber-Colman engineering sales office: Baltimore, Boston, Dayton, Fort Worth, Los Angeles, Montreal, New York, Rockford, San Diego, Seattle, Winter Park, Florida.

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FINANCIAL

Vought Plans to Build Skyscraper in Dallas

Dallas, Tex.—Ling-Temco-Vought, Inc., is taking a further step to strengthen and consolidate management operations by cooperating with three Dallas firms on plans to erect a $12.5-million 31-story financial structure in the heart of this city's business district.

The move is interpreted by business observers here as additional evidence that Ling-Temco-Vought management feels confident of repeating, if necessary, its recent successful defense against Department of Justice Anti-Trust Division's attempt to have Ling-Temco and Chance Vought separated on charges that the merger of the firms restricted competition in the aerospace industry.

Department of Justice attorneys, following a rule in favor of Ling-Temco-Vought by U. S. District Court here, indicated that they would study records of the hearings to see if a government appeal to a higher court is justified.

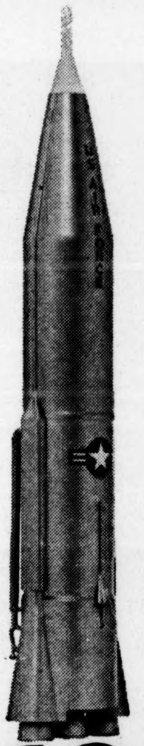
Local attorneys, who observed the trial, thought that perhaps the government's strategy was to treat the hearings before the U. S. District Court here as preliminary to appealing the case to the U. S. Supreme Court, and attempt to score a victory there so to establish a precedent for Section 7 of the Clayton Anti-Trust Act, which has not yet been tested by this tribunal. Section 7 contains language interpreted by attorneys as vaguely expressing desire for "lessening competition in the future."

If the government does intend to follow up its initial unsuccessful suit, it has until the latter part of February to reopen the case.

Plans by Ling-Temco-Vought—in conjunction with Electro-Science Investors, Inc., the National Bank of Commerce and American Life Insurance Co., all businesses in which James J. Ling (chairman of L-T-V's executive committee) is a principal stockholder—are to make the Ling-Temco-Vought tower corporate headquarters for L-T-V and Electro-Science Investors, Inc. Ground is expected to be broken on the new structure in 90 days and the building is scheduled for completion within two years.

The first three floors of the building will be occupied by the bank, the remainder by Ling-Temco-Vought, Electro-Science Investors, American Life Insurance and tenants.

Ling-Temco-Vought will move its corporate headquarters from Grand Prairie to the new building when it is completed.



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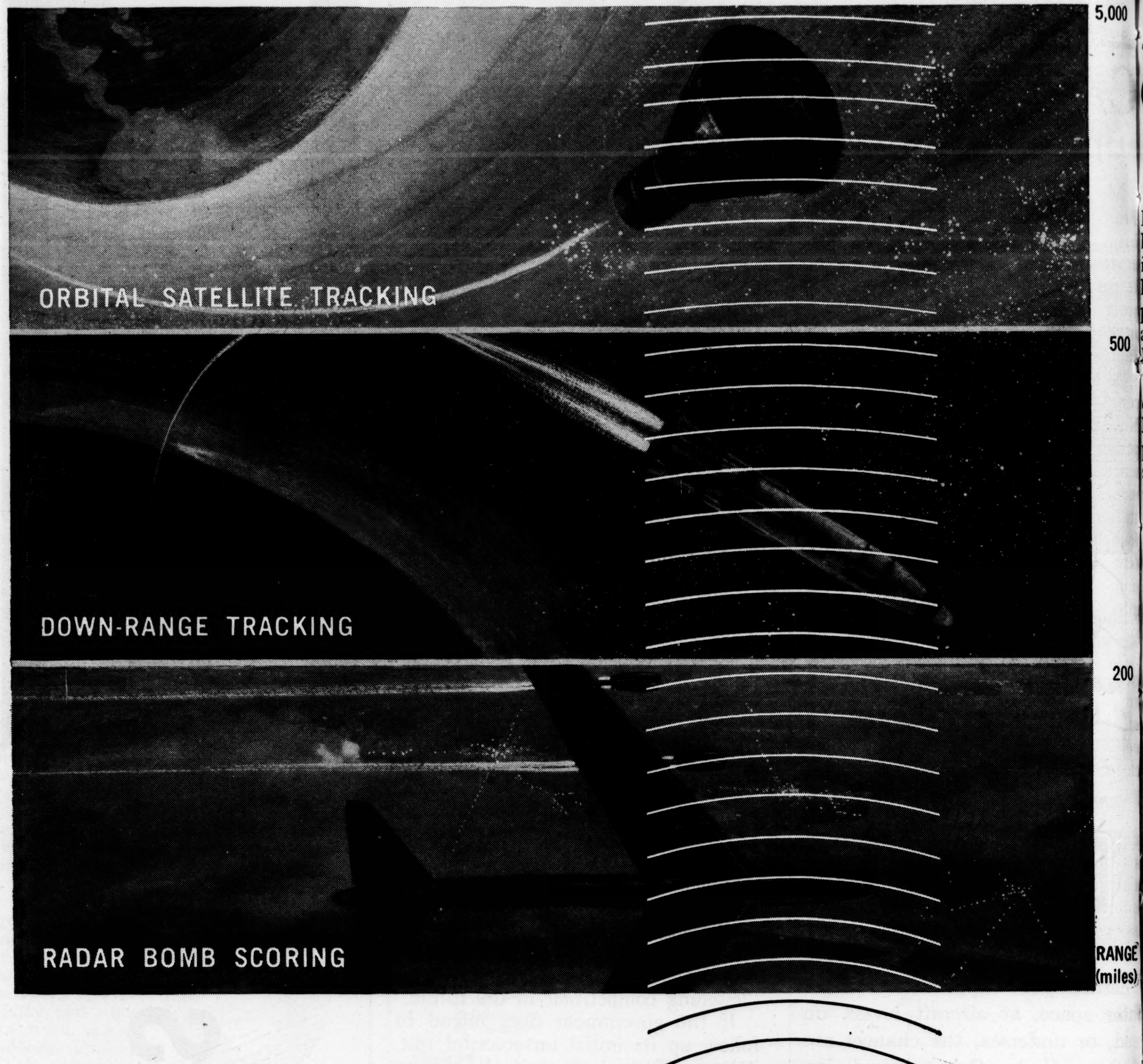

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CAB Investigates Imperial's Maintenance

By David H. Hoffman

Miami Beach—Civil Aeronautics Board investigation of Imperial Airlines has uncovered a history of discrepancies in the carrier's maintenance, record-keeping and flight crew coordination procedures that may throw light on why an Imperial aircraft crashed last month, killing 77.

Although CAB investigators were concerned only with the cause of the Nov. 8 tragedy, their questions led Imperial employes to give a detailed description of how at least one supplemental airline maintains and operates its aircraft. Lengthy records of the four-day hearing undoubtedly will receive the close attention of congressional committees planning to investigate the supplemental airline industry's safety practices (AW Nov. 20, p. 37).

The crash, in which 74 Army recruits were killed, led Defense Secretary Robert S. McNamara to order that supplemental airlines carrying military personnel within the United States receive clearance from the Military Air Transport Service (AW Nov. 27, p. 37).

The Lockheed 049 transport operated by Imperial stalled while attempting an unscheduled landing at Richmond, Va., with its No. 3 and 4 engines feathered and its No. 1 engine losing power. Only the aircraft's pilot, Capt. Ronald Conway, and flight engineer, William F. Poythress, survived.

Public Hearing

Testimony during four days of public hearings conducted in Richmond and Miami Beach by an eight-man CAB technical panel posed these crucial questions.

- **Why did Imperial's** chief flight engineer, John Mayfield, declare the Constellation airworthy after one of its fuel boost pumps had been repaired with a brush borrowed from a used 1954 Mercury automobile generator on the day before the plane's last flight?
- **Why did the airline** elect to operate the Constellation for at least 130 flight hours after purchasing an engine due for overhaul and install it on the aircraft without informing Federal Aviation Agency of the vendor's authorized time between overhaul (TBO)?
- **Why did Imperial** fail to designate one of the two qualified captains on board the aircraft as pilot-in-command? Conflict arose between the two as the plane circled Richmond's Byrd Airport with two dead engines and both pilots gave orders to the flight engineer.
- **Why did the two pilots** apparently not ensure that two valves, through which fuel and hydraulic pressure could have been obtained from the Constellation's two operating engines, were placed in an open position?
- **Why were component,** engine and airframe time control records kept by Imperial at least one week behind on the day of the accident and why, during the month of October, could no record be found of the fuel taken on by the Imperial fleet?

Testimony on the boost pump repaired with the used auto part was in sharp conflict. CAB and FAA questioners agreed that on the first hearing day, Chief Flight Engineer Mayfield stated that he had made the part fit the Constellation's No. 3 engine—one of those that failed—by cutting it with a hack saw. The next day, Mayfield maintained that the brush had been used to repair the aircraft's No. 2 boost pump at Columbia, S. C. Only the No. 2 engine remained in operation throughout the aircraft's final flight.

Whether the No. 3 engine boost pump contained a faulty part was not technically at issue in the hearing. Failure of this pump could not in itself account for the simultaneous loss of fuel pressure on the Constellation's two right-side engines that was reported by Capt. Conway. Nor could it explain entirely the inability of Flight Engineer Poythress to restart either No. 3 or No. 4 engine after the failure had occurred.

The plane's No. 3 engine, according to Manuel Lopez, Imperial's superintendent of maintenance, had been purchased from Falcon Airways when Constellation No. N 2737A was in Great Britain. At the time, the engine had been flown 1,163 hr. since overhaul, and Falcon's authorized overhaul time was about 1,150 hr. as fixed by the British Air Registration Board.

Lopez, a former Cubana flight engineer who defected to the U. S. last January, indicated that because Imperial's TBO on the engine was 1,400 hr., continued operation of the powerplant was legal. Engine was at about 1,300-hr. mark prior to the accident.

At the hearing, FAA officials failed to cite any agency rule or policy that would have prohibited the acquisition of a time-expired engine from a foreign airline. However, George G. Reid, principal FAA maintenance inspector assigned to Imperial, stated that he would not have permitted the transaction if the engine had been operated to its TBO by a U. S. carrier, even if that TBO were lower than Imperial's.

The dual engine failure was experienced by the Constellation's crew when the plane was southwest of Richmond. Turning eastward, Capt. Conway made a decision to land on Byrd Airport Runway 33, an 8,000 ft. strip pointed almost directly into the prevailing wind. Conway's intent was to make a shallow left turn into his good engines and thus line up gradually with the runway.

Cockpit Dissension

As he approached the field, however, the copilot, Capt. James A. Greenlee, actuated the landing gear lever, insisted that the landing be made on Runway 02 and took over control of the aircraft, Conway said. Approach to 02 necessitated a sharp turn to the left and a rather steep descent. During the turn, Conway testified, the two pilots realized that they would either overshoot the runway or touch down before the landing gear had fully extended.

The decision that resulted involved a 310 deg. turn to the right to align the aircraft with Runway 33. It was during this turn that the third engine began losing power. With gear in slipstream, the pilots could not maintain altitude and the aircraft struck the ground about 1.5 mi. from Runway 33's threshold.

Conway testified: "It was not until we were just about to depart . . . that Greenlee said 'do you want to fly this flight and I will operate as copilot?' We agreed on that." Despite FAA regulations that require an airline to designate the pilot-in-command of each flight, Imperial's unwritten policy was to allow qualified captains to exchange legs on any multi-leg mission, Capt. Warren M. Young, Imperial's chief pilot, testified. As a result, he said, when a flight involved several landings, the company could not ascertain which captain was in command on a given leg.

While the aircraft was maneuvering over Byrd Airport, the student flight engineer on board went aft into the passenger cabin to open the midship fuel cross-feed valve, Conway testified. This valve, which is kept closed in normal flight, must be opened if fuel is to be transferred from the left wing tanks to the right wing tanks, or vice versa. By lifting the aisle runner and removing a cover plate, the valve becomes accessible and can be turned by hand.

Conway testified the student, who held an airframe and powerplant mechanic's license, returned to the cockpit to get a screw driver. Greenlee, technically and legally the co-pilot but also

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line check captain for Imperial, or-ered the student flight engineer not open the cross feed valve. Veteran onstellation pilots at the hearing could ot offer any reason for this command.

During the Richmond stage of the vestigation, CAB officials testified that any fuel injection nozzles from all ur engines found in the Constella-on's wreckage contained two types of oreign material." One type, they said, as black and non-magnetic in char-ter, and the other was reddish brown d magnetic. Last fueling of the air-aft took place at Columbia and was complished from two trucks operated Aircraft Sales and Service Co.

On the Constellation, another valve ermits hydraulic fluid under pressure cross over from the aircraft's primary stem, operated by its No. 1 and No. engine driven pumps, to its secondary stem, supplied by No. 3 and No. 4 umps. Secondary system pressure helps ck the nose gear in place during a ormal extension cycle and releases the ain gear uplocks. When this pressure not available, the gear may be locked own in about five to six minutes with manually operated pump handle.

Although Conway testified that he dered this hydraulic cross over valve ened over Richmond, the valve was covered from the wreckage in a closed osition. CAB questions also brought t that the hydraulic hand pump in e Constellation's cockpit was being erated just prior to ground impact.

On Imperial's record-keeping prac-ces, Chief Inspector Reid testified that e airline system was "very faulty," d that records "fell far behind the tual accomplishment of work," so that was difficult to detect the "actual ondition of the carrier" at a given time. dmitting that Imperial met the min-num standards laid down by civil air gulations, Reid found particular fault ith the manner in which Imperial ght crews airmailed discrepancy and aintenance reports from the field to e airline's Miami headquarters.

As a result, he said, subsequent flight ews could not adequately inspect pre-ous aircraft and flight engineer logs. eid said that he had recommended anges in this procedure early in Aug-t and given Imperial until Oct. 1 to omply. Still not satisfied after this eadline had passed, he wrote the ompany on Oct. 28 advising its officers hat FAA would and would not accept the way of specific reporting pro-edures, he said.

Superintendent of Maintenance Lo-ez and Jose Serra, chief maintenance spector, both hold airframe and owerplant licenses issued by FAA, as the airline's flight engineers. But all Imperial's full-time ground me-anics hold only Cuban certificates.

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WHO'S WHERE

(Continued from page 23)

Changes

Dr. Hiden Cox, assistant administrator for public affairs, National Aeronautics and Space Administration.

Maj. Gen. Wiley D. Ganey (USAF, ret.) has been appointed as Member Senior Staff, Management Systems Division, Operations Research, Inc., Santa Monica, Calif.

Joseph A. Barkley, technical representative-aerial recovery systems in Hawaii for All American Engineering Co., Wilmington, Del., succeeding **Harry Conway** who is returning to Wilmington.

A. K. Rossetter, Jr., production planning manager, Aircraft Radio Corp., Boonton, N. J. Also: **G. V. Smith**, commercial sales manager, and **R. E. Gifford**, sales administration manager.

Louis Branzburg, chief engineer, Walder Kohinoor, Inc., Long Island City, N. Y., succeeding the late **Dr. Oswald Kolbert. Lester Coch** succeeds Mr. Branzburg as quality control manager.

Dr. Philippe A. Clavier, director, Engineering Sciences Division, Plasmadyne Corp., Santa Ana, Calif.

C. H. Plyer, director of logistics support, The Martin Co., Orlando Division, Orlando, Fla. **A. E. Namey** succeeds Mr. Plyer as program manager-Lacrosse program.

Paul Moschella, chief of manufacturing planning, United Aircraft Corporate Systems Center, Windsor Locks, Conn.

Jack D. Porter has been named head of a newly formed Mathematical Analysis Department at The Mitre Corp., Bedford.

Hugh Brady, associate department manager, Inertial Guidance Department, Electromechanical Laboratory, Space Technology Laboratories, Inc., Los Angeles, Calif., and **Dr. Louis K. Jensen**, department senior staff engineer.

Vern E. Leas, director of military program management, Military Department, Univac Division of Sperry Rand Corp., St. Paul.

Milton Waltcher, manager-contracts administration, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn. Also: **Anthony F. Dernbach**, executive assistant to the general manager; **John C. Sterling, Jr.**, program manager-electron beam; **Dennis Goddard**, sales manager-electron beam products.

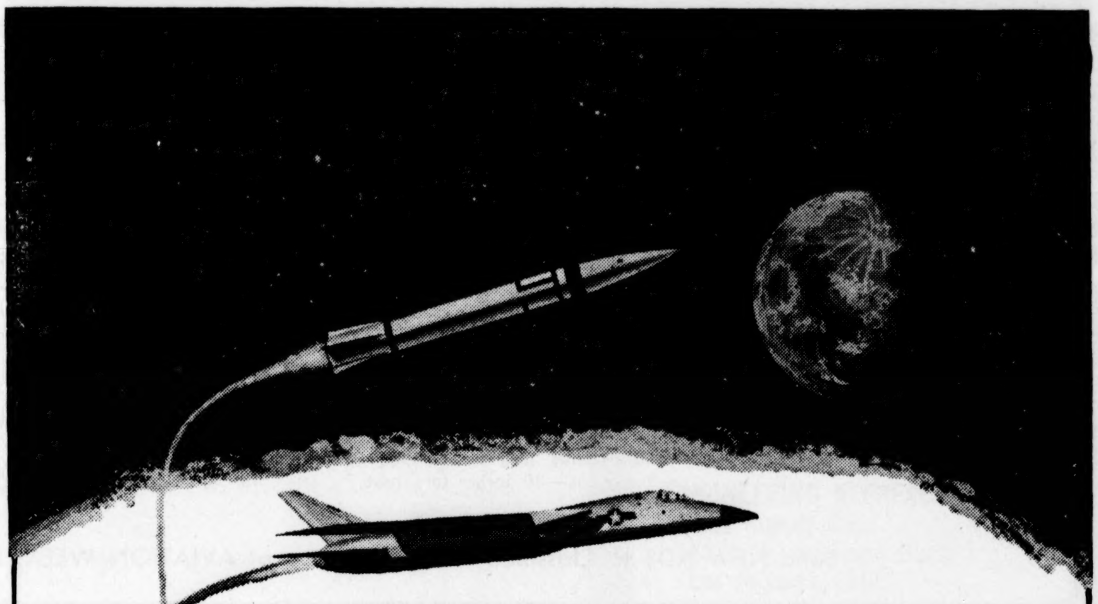
Dr. Ward C. Low, technical director, Systems Division of LFE Electronics of Laboratory for Electronics, Inc., Boston, Mass.

Everett S. Glines, general manager, Republic Aviation Corp.'s Missile Systems Division, Mineola, N. Y.

Dr. James G. Berry, director of the newly established Development Engineering Department, Titan Missile Program Office, Space Technology Laboratories, Inc., Los Angeles, Calif., a subsidiary of Thompson Ramo Wooldridge, Inc. Associate Directors of Development Engineering are **Dr. Robert Haldin** and **Bernard M. Willett.**

Howard E. Britton, manager, Engineering Services Group, Instrument Division of Bourns, Inc., Riverside, Calif.

Robert R. Stephens, chief electronics engineer, Vitro Electronics, Silver Spring, Md., a division of Vitro Corp. of America.



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Staff Specialist or Project Engineer, to conduct continuing analysis in hydroacoustics and signal processing techniques for acoustic detection and communication systems.

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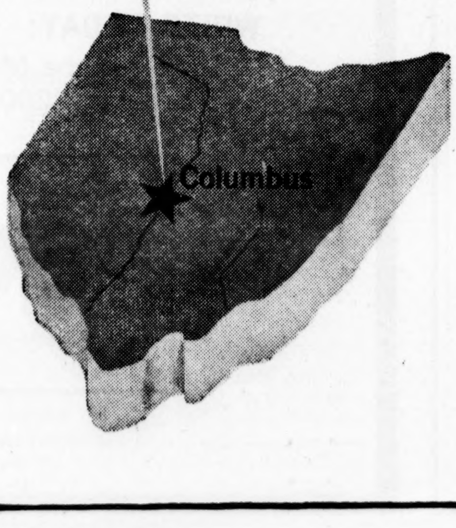

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See page 82

LETTERS

More on the X-15

1. Congratulations to Aviation Week on two very timely and informative articles on the X-15 in the Nov. 20 issue.

2. I think, however, that further clarification should be given regarding the 100% increase of the design limit on altitude and the new adaptive flight control system installed in the number three X-15. The program to develop this system was initiated in 1959 by the Flight Control Laboratory, ASD. The objective of the program was to design and test a system which would be capable of controlling a class of orbital, lifting re-entry vehicles, and the X-15 was selected as the test vehicle to demonstrate the capabilities of the system. It had been determined that the range of control parameters and the rate of change of these parameters on the X-15 was as great or greater than those projected for other lifting vehicles.

3. At about this time the design altitude of the X-15 was lowered from 500,000 ft. to 250,000 ft. primarily due to flight control limitations of the existing X-15 system. In 1960, the study program on the adaptive system had shown that it would overcome these limitations. Therefore discussions were started which debated raising the design altitude again for the number three X-15 and retrofitting the system into the first two X-15s if the adaptive flight control system demonstrated, in flight, the same capability it had shown when operated on the X-15 Iron Bird simulator.

4. That this new adaptive system will increase the capability of the X-15 is a fortunate aspect of serendipity. The primary objective was to develop a completely automatic system including angle of attack, attitude, and heading hold modes with complete stability augmentation with the reliability and fail safety capability required for future vehicles. That the system accomplished this is borne out by the fact that these same X-15 concepts are now being applied to future weapon system development.

Lt. Col. George M. Manning
Chief, Flight Control Laboratory
Wright-Patterson AFB

Your articles on the X-15 research program (AW Nov. 20, p. 52, and Nov. 27, p. 57) give an excellent account of the significant accomplishments of the program. The editorial "Salute to the X-15" (AW Nov. 20, p. 21) gives well-deserved credit to many of the men who helped make these accomplishments possible. However, I feel that at least one more name should have been mentioned: that of USAF Capt. Iven C. Kincheloe, who was slated to be the primary USAF pilot of the X-15 until his untimely death in an F-104 accident at Edwards in 1958.

Ralph L. Merrill
Long Beach, Calif.

I would like to correct some misinformation which you published in "X-15 Objectives Raised to New Limits" (AW Nov. 20, p. 52).

The XLR-99 engine has, to this date, never exploded during any testing here at Edwards AFB. The explosion on 8 June 1960 which destroyed X-15 A/C #3 was a result of a double malfunction in the pressurizing system of the NH_3 tank. The NH_3 tank exploded, not the engine!

Walter R. Wagner
Propulsion Branch Engineering
FTFSPE Edwards AFB., Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Titov Flight

The article on the recent Russian documentation of Titov's flight (AW Nov. 27, p. 28) states that ". . . it contains little additional information on the launch vehicle. . . ." This is a surprising statement since the launcher thrust, long the subject of mystery, controversy, and speculation, has finally been officially released (and reported by Aviation Week.)

Actually, the figure given tells us more than just the thrust itself. For example, we note that it is given to four significant figures. Why would they do that since rocket thrusts cannot be measured that accurately? Obviously, it is because the thrust was specified in metric tons in round numbers and then converted to pounds. The stated value of 1,323,000 lb. is equal to 600 metric tons.

The launcher used six engines with a total thrust of 600 metric tons. If any of the engines were R-14's at 100 metric tons, then all must have been R-14's. Or if the Russians have designed their engines to even hundreds of metric tons, then they must all be of equal thrust and all R-14's.

Of course, we can think of combinations such as four engines of 120 metric tons plus two at 60 but this requires that both types of engines have round numbered thrusts. It seems a little unlikely that such a combination would add up to exactly 600 metric tons.

The previously released total horsepower of the launcher engines of 20 million when combined with the new figure for thrust indicated an exhaust velocity of 8,300 ft. per sec. or a specific impulse of 258 pound seconds per pound. This lends some support to the assumption that they are using lox and kerosene propellants rather than some more exotic combination such as hydrogen and oxygen.

The question remains as to whether all six engines are used on take off in some kind of parallel or lateral staging arrangement—as in Atlas—or whether the more conventional tandem arrangement—Titan, Saturn, etc.—is used.

If the number of engines used in a vehicle is the major determining factor—because of engine cost and reliability—then it can be shown that the largest payload can be boosted by using the specified number of engines of equal size in a lateral combination. This gives the highest gross weight and highest payload. It does not necessarily give better gross weight to payload ratios but tanks and propellants are very inexpensive compared to engines, instrumentation, etc. It may be that the Russians are using this design philosophy and that all six engines are used at takeoff.

Using this approach, the gross weight could be about one million pounds and the gross weight to payload ratio 100 fo Vostok and 71 for the Venus probe or bital payload (14,000 lb.). The latter figur for gross to payload corresponds to our bes performance to date. Any lower takeof thrust than the full 1.32 million lb. woul mean that they have more efficient de signs than our own. This seems highl unlikely. It seems much more probabl that they have achieved higher payload per formance simply by using larger size ve hicles using the same propellants and th same general level of design efficiency w have attained here.

D. M. Cole
General Electric Co.
Missile and Space Vehicle Dept
Philadelphia, Pa.

(Russia gave the total thrust of 6,00 kilograms in the Titov claim. Aviatio Week *converted this to pounds, roundin off the last three zeros. Using 2.20462 a the multiplier, the unrounded figure wa 1,322,772 lb.—Ed.)*

Swiss Pilot Training

Thanks for your excellent article on Swis pilot training (AW Nov. 20, p. 111). Yo correctly pointed out that at age 19 th candidate is assigned to a specific service It is there on some military base in Switzerland, and not necessarily at Payern, wher the man's military life begins at age 20 The service chosen for him according to th best of his abilities, be it Infantry, Sk Troop or Technical Corps, has the job t first and foremost make a soldier out of th man. A large number of candidates ar eliminated during this nine week period o tough basic training. The lucky ones ge to go to Primary Flight School at Locarn where the elimination process continues

A further point of interest may be th fact that a Swiss pilot or serviceman's ob ligation to his country does not cease whe he leaves Switzerland to take up residenc in another country. He is then obliged to pay 2½% of his yearly income, called military tax, for a period of eight years This is the price he pays for enjoying freedom while his comrades at home do their yearly compulsory tours of duty.

Aside from these minor points your r port was very accurate, indeed.

P. A. Reithaar
Issaquah, Wash.
Formerly of Dubendorf, Switzerland